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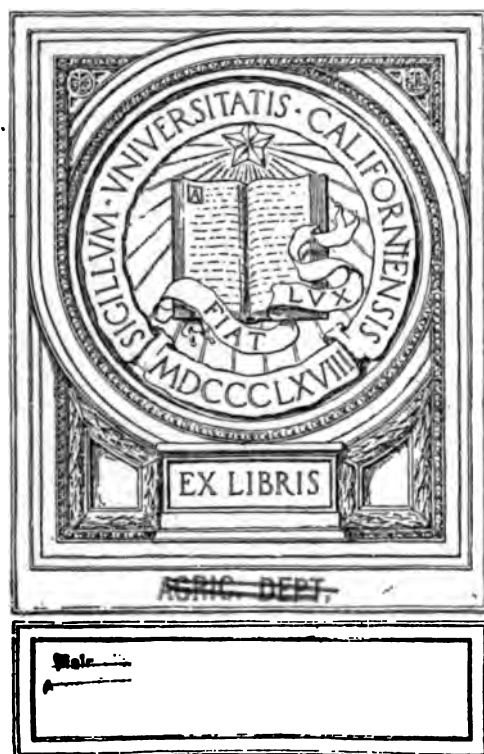
1899

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23rd Report.

1899.

2nd Series, No. 1.

REPORT
OF
E. J. Wicks
INJURIOUS INSECTS

AND
COMMON FARM PESTS

DURING THE YEAR

1899

WITH METHODS OF
PREVENTION AND REMEDY.

BY
ELEANOR A. ORMEROD,

F.E.S., M.F.S., SOC.

LATE ASSISTANT EXAMINER IN AGRICULTURAL ENTOMOLOGY IN THE UNIVERSITY OF BRISTOL;
FELLOW ENT. SOC. LONDON; SEN. FELLOW ENT. SOC. STOCKHOLM; MEMBER ENT. SOC.
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NATURALIST SOC. CAPE BRETON.

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Handbook of Insects

INJURIOUS TO

Orchard & Bush Fruits

WITH MEANS OF PREVENTION AND REMEDY.

BY

ELEANOR A. ORMEROD, F.R.Met.Soc., F.E.S.,

Additional Examiner in Agricultural Entomology at the University of Edinburgh.

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Obituary.—All lovers of insect study will regret to hear of the death of Miss ELIZABETH A. ORMEROD, the well-known English entomologist, which occurred at St. Albans, Hertford, last Friday, July 19, at the age of 53. Miss Ormerod was the daughter of George Ormerod, an extensive land-owner in Gloucestershire and Lancashire, and as a child was interested in the study of insects, increasing her knowledge until she became one of the best authorities on the subject in England. Her later researches and experiments were of great economic value to the farmers and fruit-growers of the United Kingdom, whose crops she has saved many times from insect ravages. In 1873 she was elected a fellow of the Royal Meteorological Society—the first woman so admitted; in 1892, was elected consulting entomologist of the Royal Society of England; for some time was examiner in agricultural entomology for the University of Edinburgh, receiving from that institution last year the first degree of doctor of laws that it ever conferred upon a woman. In 1872 she received a gold medal and two silver medals at the Russian International Exhibition; in 1899, a silver medal from the Société Nationale d'Acclimation de France. Among her published works are "A Manual of Injurious Insects," "Guide to Methods of Insect Life," "Text-Book of Agricultural Entomology," "Observations on Injurious Insects of South Africa," and "Flies Commonly Injurious to Live-Stock."



Horace Knight del. et sculp.

West Newman lith.

Foot of Horse Fly (*Hippobosca equina* Linn.)
Seen from above greatly magnified.



Horace Knight, ad nat. del.

West, Newman lith.

Foot of Grouse Fly. (*Ornithomyia avicularia*, L.)
(Greatly magnified.)

OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS
DURING THE YEAR
1899
WITH METHODS OF
PREVENTION AND REMEDY.

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ELEANOR A. ORMEROD,

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TO THE
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PREFACE.

DURING the past season reports of observation of a great variety of insect infestations were forwarded, many of these being of our ordinary farm and orchard pests, but some also which had been little previously noticed, and of others details of habits, or of preventive measures, were contributed, serviceable for completing previous notices. The only crop attack, however, which was mentioned as seriously prevalent was that of Turnip Flea-beetle. The caterpillars of Cabbage Butterflies (as in the previous season) did a good deal of damage locally; and for about six to eight weeks from May 20th much application was sent for leaflets on Wireworm, sometimes amounting to five or six applications daily.

Some infestations which are often seriously injurious were little reported—as Surface Caterpillars to root crops; and Mangold-leaf Fly maggots; orchard caterpillars (including amongst them those of the Winter Moth) were little noticed; the caterpillars of the Gooseberry and Currant Moth and Sawfly were also little mentioned.

Amongst field crop attacks, some addition to previous information was noted in regard to different kinds of “Pear-shaped Weevils” at Clover seed-heads. Amongst Corn attacks, some of the well-known kinds—as those of the maggots of Oat Frit Fly, Wheat-bulb Fly, and Corn Sawfly within Wheat stems—were just enough reported to show they were not absent, as also Hessian Fly in Wheat in one locality, and I would most particularly desire to draw the attention of agriculturists (in case of this infestation occurring again in the country) to the notes given at p. 39, on the importance of *destroying* infested screenings with the contained chrysalids, the so-called “Flax-seeds.” With regard to insect infestation in flour, whether as a generally spread home trouble in mills, &c., or in imports, the communications were on a much larger and graver scale than in any preceding year, and I have especially drawn attention to details connected with the “Mediterranean Mill Moth” in a paper under that heading, pp. 76–92. Amongst Hop observations a good working observation was given of possibility of broadscale trapping of the Click Beetles (the parents of the Wireworms); also notes of Hop Flea Beetle on the leafage, helped to give some additions needed to connect this attack in summer with that of the maggots later on in the Hop cones. Very little was

mentioned about Mangold injury, and no new information contributed about attacks on these or Turnip crops.

Amongst Fruit attacks some notes were sent of mischief caused by the very small caterpillars of the Eye-spotted Bud Moth feeding at the end of Apple shoots amongst the bunches of opening leaves, and blossoms,—an attack which has only recently been noticed, and on which more observations are needed. On Currant leafage the caterpillars of the so-called Spinach Moth have not been previously reported, and some observations are given on *non-transportation* of the Black Currant Gall Mite in earth at roots of removed bushes.

The Pear Gnat Midge attack to very young Pears, which was first noticed as seriously prevalent in 1898, was very little reported, and on special enquiry in 1899, at the localities of infestation, had been checked very satisfactorily where the requisite treatment had been applied. The Raspberry Moth and Strawberry Ground Beetles also it is found can be kept thoroughly in check by the remedial measures noted.

Diptera (two-winged flies, and more especially animal flies) were more than usually enquired about; and of the two kinds mentioned which are not known as doing much harm with us, the rare Red-bearded Throat Bot Fly of the Deer is mentioned as giving another record of presence, and at the great altitude of three thousand feet; and the Grouse Fly as giving a little more record of its pupal stage, and opportunity for securing a figure (see frontispiece) of the elaborate structure of its foot. The Cheese and Bacon Fly is a severe trade trouble, which I am obliged by practical assistance in bringing forward.

The following list gives the names of the most important of the British infestations regarding which enquiries have been sent, mostly with specimens accompanying.

Beetles (*Coleoptera*).

Ash-bark Beetle ("Greater Black"), <i>Hylesinus crenatus</i>	In Ash trees.
Cadelle, <i>Tenebrioides (Trogosita) mauritanicus</i>	Stored grain and insects.
Cockchafer, <i>Melolontha vulgaris</i>	Leafage and crop roots.
Death-watch Beetle, <i>Anobium paniceum</i>	Seeds, stores, &c.
Flea Beetle (Hop), <i>Psylliodes attenuata</i>	Hop plants and cones.
" (Turnip), <i>Phyllotreta</i> (various species)	Turnip leaves.
Flour Beetle (Confused), <i>Tribolium confusum</i>	Stored flour.
" (Rust-red), " <i>ferrugineum</i>	"
Ground Beetle, <i>Harpalus ruficornis</i>	Strawberry fruit.
Mustard Beetle, <i>Phaedon betulae</i>	Mustard.
Turnip Flower Beetle, <i>Meligethes aeneus</i>	Turnip flowering shoots.
Weevils, Black Vine, <i>Otiorhynchus sulcatus</i>	Vine leaves, roots, &c.
" Clover Black-footed, <i>Apion nigritarsee</i>	Chiefly in Clover heads.
" Clover-head, <i>Apion trifolii</i>	" "
" Clover Purple, <i>Apion apricans</i>	" "
" Downy Brown, <i>Phyllobius oblongus</i>	Orchard leafage.
" Granary, <i>Calandra (=Sitophilus) granaria</i>	Stored grain.
" Pea and Clover-leaf, <i>Sitones</i> (various species)	Leafage.
Willow (Mottled) Beetle, <i>Cryptorhynchus lapathi</i>	In Alder and Willow.
Wireworms, larvæ of <i>Agriotes obscurus</i>	Roots of crops of many kinds.
" " <i>sputator</i>	" "
" " <i>Athous rhombeus</i>	Sometimes carnivorous.

Butterflies and Moths (*Lepidoptera*).

Buff-tip Moth, <i>Pygæra bucephala</i>	Leaves.
Cabbage White Butterflies, Large, <i>Pieris brassica</i> . . .	Cabbage leaves.
" " " Small, <i>Pieris rapæ</i>	"
" " " Green-veined, <i>Pieris napi</i>	"
Common Vapourer Moth, <i>Orgyia antiqua</i>	Fruit-tree leafage.
Currant ("Spinach") Moth, <i>Cidaria dotata</i>	Currant leaves.
Death's-head Moth, <i>Acherontia atropos</i>	Potato leaves.
Diamond-back Moth, <i>Plutella cruciferarum</i>	Turnip leaves.
Eyed Hawk Moth, <i>Smerinthus ocellatus</i>	Apple leaves.
Eye-spotted Bud Moth, <i>Tmetocera ocellana</i>	Apple buds and leaves.
Lobster Moth, <i>Stauropus fagi</i>	Leaves of Oak, &c.
Mediterranean Mill Moth, <i>Ephestia kuhniella</i>	Stored flour.
Privet Moth, <i>Sphinx ligustri</i>	Privet leaves.
Puss Moth, <i>Dicranura vinula</i>	Poplar and Willow leaves.
Raspberry-bud Moth, <i>Lampronia rubiella</i>	Raspberry flowers & leaf-buds.
Surface Caterpillars (<i>Agrotis</i> of various species) . . .	Roots of Turnips, corn, &c.
Wood Leopard Moth, <i>Zeuzera æsculi</i>	Wood of Pear branches, &c.

Two-winged Flies (*Diptera*).

Cabbage-root Maggots, <i>Anthomyia</i> sp.	Cabbage roots.
Cheese and Bacon Fly, <i>Piophilæ casei</i>	Cheese and Bacon.
Daddy Longlegs (Cabbage), <i>Tipula oleracea</i>	Roots of Grass, Strawberry, &c.
" " (Spotted), " <i>maculosa</i>	"
Deer Forest Fly, <i>Lipoptera cervi</i>	On Deer.
Deer Throat Bot Fly, <i>Cephenomyia rufibarbis</i>	Nostrils & throat of Deer.
Frit Fly, <i>Oscinis frit</i>	Young Oat plants.
Grouse Fly, <i>Ornithomyia avicularia</i>	On Grouse.
Hessian Fly, <i>Cecidomyia destructor</i>	Barley and Wheat stems.
Horse Bot Fly, <i>Gastrophilus equi</i>	Horses, internally.
Ox Warble Fly, <i>Hypoderma bovis</i>	In hides of cattle.
Pear Gnat Midge, <i>Diplosis pyrivora</i>	Young Pears.
Sheep's Nostril Fly, <i>Estrus ovis</i>	Sheep's nostrils.
Wheat-bulb Fly, <i>Hylemia coarctata</i>	Young Wheat plants.

Sawflies, &c. (*Hymenoptera*).

Corn Sawfly, <i>Cephus pygmaeus</i>	Inside Wheat stems.
Sirex, Giant, <i>Sirex gigas</i>	Pine timber.
" Steel-blue, <i>Sirex juvenus</i>	"
Slug-worm of Pear Sawfly, <i>Eriocampa limacina</i>	Pear and Cherry leaves.

Crickets, Cockroaches (*Orthoptera*).

House Cricket, <i>Acheta domestica</i>	General feeders in houses.
Cockroach, German, <i>Phyllodromia germanica</i>	" "

Aphides, Scale Insects, &c. (*Homoptera*).

Aphis, Woolly Apple, "American Blight," <i>Schizoneura lanigera</i>	Apple bark.
Scale, Apple, Oyster Scale, <i>Mytilaspis pomorum</i>	Bark.
" Beech "Felt," <i>Cryptococcus fagi</i>	Beech bark.
" Currant and Gooseberry, <i>Lecanium ribis</i>	Bark.

The above list gives names of the most important of the attacks regarding which communication has been made. There has been also enquiry regarding attacks of crop pests commonly known as insect allies, as Julius-worms, or False Wireworms, Eelworms, &c.; and of two of these attacks, entered on in detail, that of the Snail-slug is given on account of it being so *beneficial*, by preying on earth vermin, that it is desirable that it should not be destroyed as an ordinary Slug; and the "Planarian," or

"Flatworm," as, from its repulsive snake-like appearance, it may save a little uneasiness for it to be known that any small harm it may do is to plants only.

An unusually small amount of enquiry was sent with regard to timber-infesting insects, excepting the Pine-injuring Giant Sirex, which, from its great size and bright yellow markings, attracts much attention.

Extra-British communication has been greater than usual, including more especially enquiries as to attacks from Cape Town, also at Siam, in Ceylon, at Las Palmas (Canary Islands), Helsingfors (Finland); and investigation as to presence of various kinds of flour-infesting insects in imports from various countries.

The different arrangement commenced in this first number of my Second Series of giving a division of "Short Notices" (see p. 137), following the special Insect reports, has been adopted in order to utilize contributions of observations which may possibly *lead on* to more complete information on special attacks, or are serviceable as making *previous observations more complete*, without unnecessary repetitions regarding histories and habits.

Information given in the twenty-two preceding Reports is made easily attainable by the excellent Index,* prepared by Mr. R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, in which fully detailed reference is given, including the scientific and popular names of the insects, with coincident points of serviceable interest—as dates of first or of great appearances, remedial applications, &c.; and likewise a Plant Index is added, with references to insect infestations, arranged under the heading of each kind of crop or fruit plant attacked; and an Animal Index is also given.

The amount of enquiry during the past season has been as much, or more, than in previous years; but there is great satisfaction in it being obvious that serviceable *practical* knowledge of how to deal with our ordinary crop and fruit pests (as well as application of information) has been taking such good root in the country as must be saving much agricultural loss.

With the help of my secretary, Miss Hartwell, I am able to attend to all applications sent, with only a little delay when they are more than usually numerous. Should entomological aid be necessary, I have arranged, as I mentioned previously, to ask the co-operation of Mr. R. Newstead; but in this case *I should not fail to acknowledge the assistance*. In my present number I am indebted to him for compilation of the Index, and for contribution of a valuable observation on Pear Sawfly, also on Black Currant *Phytoptus*; but these, as well as the information from *all* my other kind contributors, are duly acknowledged in connection with the information given.

My thanks are gratefully offered to many kind co-operators, not only for special help by letter, but also the assistance from

* See 'General Index,' advertised on wrapper.

the only too liberal donations of entomological works with which I am constantly favoured by presentation of Colonial and Continental publications, and likewise from the United States of America, including the admirable publications of their Department of Agriculture, embodying both practical and scientific information, the value of which cannot be too widely appreciated.

In regard to the illustrations in this number, those at pp. 1, 3, 20, 26, and 64 are given by kind permission of Messrs. Blackie & Son, Glasgow, N.B.; that at p. 46 is from Newman's 'British Moths'; that at p. 101 from the 'Gardeners' Chronicle'; the *Phytoptus* at p. 40 is by permission of Dr. Nalepa; and the *Ephestia kuhniella* at p. 76 is from Farmer's Bulletin No. 45, U.S.A. Department of Agriculture, Washington; the others have been almost entirely figured from life for this series of Reports.

In the coming season I shall hope to give my best attention in careful reply to all enquiries which may be sent to me, and I offer my sincere thanks to all my co-operators through whose help I have been able, through the long series of twenty-three years, to lay the trustworthy observations of practical agriculturists and observers of farm and orchard pests before the public.

ELEANOR A. ORMEROD, F.E.S.

TORRINGTON HOUSE, ST. ALBANS :
March, 1900.

List of Injurious Insects, &c., noticed in this Report.

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NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING
1899.

CABBAGE.

CABBAGE BUTTERFLIES—Large White, *Pieris brassicæ*, Linn.
Small White, *Pieris rapæ*, Linn. Green-veined White,
Pieris napi, Linn.



PIERIS BRASSICÆ.—1, female butterfly; 2, eggs; 3, caterpillar; 4, chrysalis.

THE past season, and also the summer of the preceding year (1898), have both been noticeable for the great prevalence of Cabbage butterflies in various localities. In 1898 the devastation of the caterpillars in some places completely ruined the Cabbage crops. The leaves were eaten to mere shreds, consisting of only the mid-rib and some amount of side veins; and even if the plants were not killed, such growth as the remnants of life left in them enabled them to make was delayed

till so late in the year that it was too weak to be of much service, and the result was great loss to market gardeners, and much inconvenience to householders from non-supply of such a convenient vegetable in its usual plenty and luxuriance.

In the past season, although severe in some localities, I am not aware of the mischief having been as great as in 1898; and though the infestation has been very frequently referred to in previous Annual Reports, it seems worth while to allude to it again, as some few additional points bearing on preventive measures can be added, and some also of description of the early stages.

All of our Brassicaceous crops which afford convenient feeding-ground on tender leafage at the time that the butterflies are about—as, for instance, Broccoli and Cauliflower, and the spreading leaves of Brussel Sprout plants before the rosettes are developed—are liable to attack, as well as the kinds especially known as “Cabbage”; Turnip leafage may also be attacked, and there is record of the Hearted Cabbage being attacked in the same manner as by the caterpillars of the Cabbage Moth.

The butterflies are so well known that it is not necessary to give a detailed description, more especially as there do not appear to be any other kinds of white butterflies which occur similarly in flocks on Cabbage crops in this country.

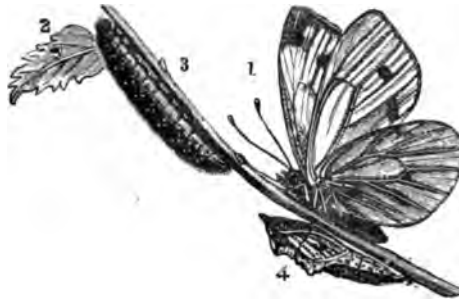
There are three kinds of these Cabbage butterflies—the “Large White” (*Pieris brassica*), the “Small White” (*Pieris rapæ*), and the “Green-veined White” (*Pieris napi*); all of these three kinds are white, more or less marked with one or two spots, and tipped with black or grey, on the wings, and all of them were formerly said to lay their eggs on the under surface of the attacked leafage; but more recent observations have shown that the eggs of *P. brassica* may be laid on either side of the leaf.

Of the above-named kinds *P. brassica*, figured at p. 1, is the largest; and the caterpillars are distinguishable by their large size, and by being greenish or bluish in colour above, and yellow below, with a yellow line along the back, and another showing more or less clearly along each side, and also by being very observably spotted, or blotched, or almost striped with black along the upper part; also they have tufts or a sprinkling of hairs. The chrysalids, which are suspended to some support by a silken thread passed round them (see figure, p. 1), as well as those of the other two kinds named, are of various shades of green with some yellow markings and black dots and spots. The eggs are somewhat flask-shaped, laid in clusters at times on the upper * as well as the under surface of the leaf, and affixed by one end.

* See ‘Larvæ of British Butterflies and Moths,’ vol. i. “Butterflies,” p. 150, by (the late) William Buckler. Ray Society.

The Small White is about two-thirds of the size of the Large White in expanse of the fore wings, this being about two inches, and the Large White from two and a half to three inches. The caterpillars are velvety when full grown, green or dull green, much paler below, with a yellow line along the back, and a faint yellow line with a row of yellow spots along each side. The chrysalids are variable in colour; pale flesh brown, dusky drab, or greenish, are some of the colours named; some with a freckling of black, some finely powdered over the back with black, and some with "a rosy pink" or dull green tinge suffused all over them. The eggs are laid singly, and (so far as yet recorded) beneath the leaves; the colour "very pale greenish yellow," gradually becoming of a more decided yellow; the shape and also attachment by one end the same as those of the eggs of *P. brassicae*, the Large White.

The Green-veined White Butterflies are so called from having broad greenish margins to the veins of the lower side of the hind



PIERIS NAPI, Green-veined White Butterfly.—1, female; 2, egg; 3, caterpillar; 4, chrysalis.

wings, which are otherwise of a sulphur or pale yellow, and may thus be distinguished from the Large White, of which the under sides of the hind wings are of a dull palish yellow speckled with black, and those of the Small White, which are similarly yellow on the under side, but thickly speckled with black towards the base. The caterpillars when full-grown are velvety, or in more detailed description "the whole skin, including the head, set with sharp points, all furnished with short hairs; the colour a full green," somewhat of a paler greyer green below; a darker green line along the back, and an indistinct yellowish green line along each side, on which are black spiracles, each in a round yellow or reddish spot. The chrysalids are mostly pale greenish or of a pinky buff, variously marked with yellow and spotted with brown, and of a brown colour at the two ends. Eggs pale green, becoming paler, otherwise of the shape, and placed like those of the Small White (*P. rapæ*).

The Green-veined White (*P. napi*) is said by Dr. Taschenberg to be the least frequently met with of the three kinds of butterflies, but still to be always quite common enough.

Where a numerous visitation of these Cabbage pests is present in garden or field, it is difficult to distinguish the butterflies excepting by size, the Large White (see p. 1) being considerably larger than the other two kinds. The caterpillars, however, may be distinguished from each other by the few chief characteristics mentioned above; and full description of the three species in their early stages from egg to chrysalis will be found at pp. 148-159 of the work referred to (*ante*) at p. 2.

PREVENTION AND REMEDIES.—In the course of the infestations of the past two seasons I have tried two preventive experiments on the Cabbage beds in my own garden, the first of which (in 1898) so *totally failed* that it may perhaps save waste of time to others just to mention it. At my desire my gardener dressed the plants with a good mixture of lime and soot, well powdered and thrown on the leaves. This did *not* appear to do the least good. The leaves were eaten back until little or nothing remained but the mid-rib and the side veins standing or hanging like strings, and of the plants which recovered so as to make something like growth, the result was really hardly worth cooking.

In the past season I was much more successful. Not long after the White Butterflies appeared as a regular infestation my gardener syringed various kinds of the Cabbage plants in the different beds with the mixture known as Little's Antipest. This is a mixture of soft soap and mineral oil, so far as I am acquainted with its chief ingredients; in fact, may be described as our British counterpart of the "kerosine emulsion" which is so greatly and successfully used in the United States and Canada for destruction of caterpillars, as a spray on leafage. Shortly after the syringing there were noticeably fewer White Butterflies in the kitchen garden than in the flower garden adjoining, and the result was such a much smaller appearance of caterpillars that, though two beds were a good deal injured, the other two borders and some lines of luxuriant Cauliflower plants were practically little harmed, and even the two first-mentioned were in fairly good order; whilst in various other gardens in the neighbourhood the condition of the attacked plants was stated to be nearly or quite as bad as in 1898. From this success (although only on the scale of experiment in my own garden) it seems to me that the plan would be at least worth trying for garden use.

For those who may care to try the kerosine emulsion itself, I give below one of the U.S.A. Dept. of Agriculture recipes for proportion of

ingredients and method of mixing,* but to those who have not the knack of combining the soap-wash and oil the process is very tedious, and unless these are so thoroughly incorporated as *not to separate*, the application is likely to be very injurious from the (then) undiluted mineral oil burning the leaves.

For this reason I use the so-called Antipest sold by Messrs. Morris, Little & Son, Doncaster, as it only requires diluting, and I have found it answer very well as an insect wash, and save both time and risk.

It might be well worth while to try the effect of syringings with a solution of soft-soap without any addition. This would be to some degree a deterrent of attack, and would help to some slight degree to support the plants by causing a damp air round them, and moistening the surface of the ground with a slightly stimulating wash *without at the same time attracting* the White Butterflies. Their attack is most prejudicial in hot and dry weather, and, so far as my own observation goes, the application of water alone is almost immediately followed by an increased amount of prevalence of the butterflies on the beds.

With regard to lessening amount of caterpillar attack by capture of the butterflies, I was favoured with the following notes by my valued correspondent, Mr. W. Bailey, Head Master of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, where, under his able superintendence, and with the full approval of the governors and of the neighbouring agriculturists, very serviceable work in attention to injurious insect prevention has been given by the boys for many years. Mr. Bailey mentioned:—

“This summer we have had quite a plague of the White Cabbage Butterflies, and dreadful havoc they have made among Cauliflower, Broccoli, and Cabbage plants. Many crops have been completely ruined in our neighbourhood. On August 9th, 10th, 11th, 14th, 16th, 21st, and 28rd, I put two boys at a time in my little garden of about a quarter of an acre with a net each to catch these butterflies. The boys were delighted to spend their dinner-hour in this work. On some of the days the boys were not engaged in this task for more than an hour. On other days when two boys had been ‘hunting’ for half-an-hour to an hour, they were relieved by two other boys. And now for

* Add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved *boiling or hot* to two gallons of petroleum or other mineral oil. The mixture is then churned as it were together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, *if the operation has been properly performed*, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, *at least nine times its bulk is needed*—that is, three gallons of “emulsion,” as it is termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage.

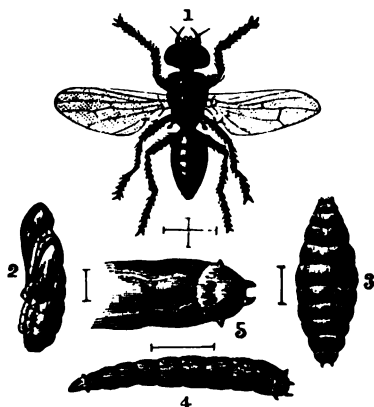
the result of this juvenile labour. In these *seven days* the boys caught and killed $83\frac{1}{4}$ of these butterflies. My winter vegetables are in excellent condition, as they have been free from caterpillars, while, as I have said, many crops in the district have been destroyed by these pests. It has been a capital 'object-lesson' not only to the boys, but also to many others in the locality. You will probably remember that last year I allowed the eggs to be laid and hatched and the caterpillars to feed for some time on the plants, and then put the boys to collect them. From two hundred and forty plants they gathered more than 5000 caterpillars."—(W. B.)

Where Cabbage is grown as a field crop, probably neither hand capture nor syringing could be brought to bear, but there are very many gardens where for an extremely small sum a couple of boys might at an hour a day for a few days do a deal towards preservation of the Cabbage and Cauliflower supply for house service. Syringing may very easily be managed without inconvenient loss of time for the few successions of applications needed.

Other remedies, such as waterings over the leaves of lime-water, or of weak brine, or of soap-suds, have been entered on before, and it cannot fail to lessen amount of coming attack to search as soon as the first chief amount of caterpillars has disappeared in summer, and also again in winter, for the chrysalids. These will be found in all kinds of garden shelters. Indoors they may be found in outhouses, potting-sheds, or the like places, in every neglected corner, as, fastened against rough walls, woodwork, or mortar, under beams, or shelves, or rough stairs, &c. Out-of-doors they may be found under eaves and pieces of rough timber, broken boards—anywhere, in short, where there is convenient and dry shelter. Clearing these out will do a deal of good, but will by no means necessarily prevent attack without co-operation in a neighbourhood, as the flocks of butterflies come on the wing.

Turning poultry on to infested ground is much recommended by some observers, but it has its drawbacks in the quantity of mischief the poultry may do if the expense of paying a watcher is not gone to. Also there is a possibility of the diet disagreeing with the birds unless some care is taken. Personally I believe that, where there are the very great insect infestations to which the aid of poultry is called in as a clearing appliance, it is prudent not to let the birds be on the ground for more than half the day, and also to be very sure that they have other food. If they had their morning meal before being driven afield, it would probably prevent them gorging themselves, and save losses which certainly in some cases—as when hard insects have been fed on to repletion, and conjecturally in others—have been rather attributable to the mass of undigested food than to any bad quality in it if consumed in moderation.

CHEESE.

Cheese and Bacon Fly. *Piophilæ casei*, Linn.

PIOPHILÆ CASEI.—1, fly; 2, pupa; 3, pupa-case; 4, maggot,—all magnified, with lines showing natural length; 5, tail extremity, still more magnified, showing spiracles, tracheae, and caudal tubercles.

Most of us, especially those who have to do with manufacture of Cheese, are only too well acquainted with the small white "hopper" maggots which put head to tail, and then, letting go suddenly, disperse themselves by "hops" or "skips" in all directions.

The infestation is prevalent in America as well as Europe, and is perhaps one of our longest definitely known economic insect pests, as the grubs, which "form themselves into an arch and leap in fat Cheese," are recorded as a North European trouble so far back as the year 1555.*

"Live Cheese," as it is called, is a cause of great loss where the infestation is not looked after in its early stages, though I am assured by various lady dairy superintendents who have been good enough to communicate with me, that by the use of careful preventive measures they suffer little; and in the course of the following pages I give notes of the treatment regarding which they have been good enough to let me have information.

But the great injury sometimes caused to Bacon and Ham by the "hopper" maggots of the same kind of fly (*Piophilæ casei*, scientifically) is much less known of, or at least much less acknowledged, and brought forward as a thing to be got rid of. It might probably save a deal of loss if this fact—that is, the similarity of the infestation—was

* See observations on "fat" Cheese, and note, p. 15.

more generally known; and as it was in my power in the last season to gain some useful information as to presence and prevention of the infestation on a large scale, as observed in the premises of one of our large Curing companies, I give in the pages 10, 12, and 18 the notes which they have been good enough to allow me to use, under promise to withhold any names which might lead to knowledge of locality.

These maggots are the larvæ of a slender shining black two-winged fly (see figure, p. 7), scarcely the fifth of an inch in length. The abdomen longly elliptical, somewhat depressed, and with some amount of fine hair at the sides and tip. Customarily the fore legs are black, with some reddish yellow at the hips and knees; and the middle, and hinder pairs, reddish yellow with some mixture of black. The wings transparent, overlapping at the edges nearly to the tips when in repose, and with pale veins.

The eggs are white (possibly sometimes pinky), slender, oblong, slightly curved, and one millimetre—that is, about half a line—in length. These are sometimes deposited singly, sometimes in clusters of from five to fifteen, and as many as thirty may be deposited by a single fly. The duration of egg condition may only be for thirty-six hours or less in summer, but appears to vary with temperature.*

The larvæ, or maggots, are whitish in colour, and legless, smooth, and shining, cylindrical in shape, tapering to the head, and truncate or somewhat rounded at the tail extremity, which is furnished above with two horny "stigmata," or spiracles, the tracheæ, or breathing-tubes, connected with these breathing-pores being clearly visible through the thin skin; beneath are a pair of fleshy processes, and there is a smaller process at each side. (See figures 4 and 5, magnified, and greatly magnified, drawn from life, at p. 7.)

When full grown the maggot measures about a third of an inch in length. The head extremity is furnished within with a pair of hooks, which serve for collecting its food, or at pleasure (when it has completed its growth, which may be in about seven or eight days) may help to drag it to the spot selected for turning to chrysalis state. These hooks are also of service in the very noticeable habit of the maggot of putting head to tail and taking long skips, or leaps, which is thus described in detail †:—"When about to leap the larva brings the under side of the abdomen toward the head while lying on its side, and reaching forward with its head, and at the same time extending

* For detailed information on this attack, see "The Cheese or Meat Skipper," by Mary E. Murtfeldt, 'Insect Life' of Dept. of Agriculture, U.S.A., vol. vi. pp. 170-175; and also "Cheese Skipper or Ham Skipper," by L. O. Howard, in 'Principal Household Insects of the United States,' Bulletin No. 4, New Series, Dept. of Agriculture, U.S.A., pp. 102-104.

† See observations by Prof. Putnam in Dr. Packard's 'Guide to Insect Life.'

its mouth-hooks, grapples by means of them with the hinder edge of the truncature, and, pulling hard, suddenly withdraws them, jerking itself to a distance of four or five inches." The length of the skips is variable, but the unpleasant habit is only too observable.

When full grown the maggot is stated to move from where it fed to some comparatively dry spot, as, for instance, the wrapper of the Cheese, or possibly of the Ham, where it has been feeding, and there it contracts to about a fifth or sixth of an inch in length, and first changes to a yellow tint, then to a golden or red brown, the outer coat becoming hard and much wrinkled at the head extremity, and still more so at the tail. This puparium, or chrysalis-case, is elliptical, about a fifth of an inch in length, and from this the fly emerges in a time that may vary from thirty-six or forty-eight hours to from eight to ten days. The longer time is given in German observations, the shorter in U.S.A. observations, and the variation may probably depend on weather and temperature. In observations on the life-history by Dr. Kessler, he found that the average time in developing from egg to fly condition is four to five weeks, with two or three generations during the summer, the last generation occurring in September, and the maggot passing the winter in the puparium—that is, in the brown chrysalis-case, and turning to the pupal state within it in May.

The chief points of the habits of the infestation, as given by comparison of the published information of the United States and European records, together with some notes of observation of attack both to Cheese and Bacon in this country, may be condensed into a small compass as follows.

The infestation (*Piophilæ casei*) may pass the winter either in fly or in chrysalis state in any convenient place, as in crannies, crevices, behind boards, anywhere, in fact, where it can hide away, and from these shelters, unless exposed to "severe and protracted cold," by which (it is said in recent observations) "larvæ, pupæ, and flies are killed," the flies come out in spring. The first application which I received in the past season regarding attack was sent me on the 29th of March, with the remark that the Cheese-room "is swarming with them now."

The flies chiefly select for egg deposit Cheese and cured meats, as Ham and Bacon, and to some (though a much lesser) extent, Salted Beef. Rich, or, as it is sometimes called, "fat," Cheese appears to be especially preferred, and they likewise attack cream Cheese. There appears no doubt that it does not lay eggs on fresh meat, and Smoked Beef is "to some extent" subject to attack, but Ham and Bacon are the special subjects for egg-laying so far as concerns cured meats. The details of nature or condition of material—namely, of the Cheese and salted, or smoked; or salted *and* smoked Pork—chosen for attack,

are given further on ; but it is plain that salt cannot be utilized as a remedial agent, both from our constant broadscale experiences, and also as it was found by Germar that the maggots would live in common salt alone.

It will be observed in the details of life-history following, that it is such a marked and recognised habit of the flies to come in from out of doors through open doors or windows, that one of the regular preventive measures in the United States is to exclude them by fixing up screens of wire-work of a mesh sufficiently small to keep them out. In a case reported to me it was said, "We closed out and indoors with open canvas." But we have no observations (so far as I can see) *whence these invading quantities of flies come.*

In the following notes with which I have been favoured, I give them as received, as it would have taken from the value of the information to separate the observations of preventive treatment from those of condition of material accompanying; and as attack to Bacon and Ham has been least entered on in this country, I give the notes on this subject first.

Attack of "hopper" maggot to Ham and Bacon.—The following communication was sent me by the secretary of one of our Ham and Bacon Curing companies, which I am allowed to give, as well as some further observations on the attack and preventive measures, under promise of withholding name and locality of inquirers :—

"We are troubled with fly in our Hams under the following circumstances, and we are now venturing to communicate with you, believing you may suggest a remedy for the evil, which is a serious one to us. We find a small long pinky egg deposited in the Ham, sometimes in its early days of cure, say two to three weeks old, but more frequently when twenty-six to twenty-eight weeks old. The eggs burst and become a nest of white hoppers similar to those found in Cheese. . . . The Hams are sweet-cured, and we hang them separately to mature, but notice in the store-room several small flies; . . . and we think the later trouble results from these. It is puzzling, however, how the fly or hopper gets in when the Ham is only two or three weeks old. Could you suggest any solution or otherwise that would prevent these flies working, or hoppers forming?"

On July 10th, the Secretary of the Company above mentioned further communicated to me, enclosing a small piece of the infested meat, and also a little bottle containing some of the flies, which, he remarked, "you will see are as you describe—small, black, and two-winged."

The flies sent were about fifty in number, and corresponded with descriptions of the *Piophilæ casei*, popularly the Cheese and Bacon Fly. They were about one-fifth of an inch in length, black and shiny, two-

winged, the wings transparent, and the neuration as given in the figure after Dr. E. L. Taschenberg at heading; the legs variable in tint, but more or less of a smutty yellow.

The maggots, of which such a good supply were sent me in the infested slice of Ham as to give excellent opportunity for observation, were (see figures from life at heading) about a quarter of an inch or somewhat more in length when extended, whitish in colour and cylindrical, tapering to the head extremity, within which the black mouth apparatus was very clearly distinguishable. The tail truncate at the extremity, which (as noticed at p. 8) showed at the upper part two small tubercular spiracles, or breathing pores, of which the connection of each with a *trachea* (or air-tube) was very plainly observable (with a two-inch object-glass); these tracheæ being traceable through the whole length of the maggot. At the lower edge of the obtusely truncate caudal extremity was a pair of somewhat pointed fleshy processes, and on each side a single smaller blunt process was observable.

Previous to leaping, the maggot fixed its black head-hooks with great care to some part of the tail extremity (taking an appreciable amount of time to arrange this matter to its satisfaction), lying the while on one side, and forming a circle of about an eighth of an inch across; but, so far as I could see, it was quite immaterial which part of the truncate end of the tail was laid hold of. Then, suddenly letting go, the maggot "skipped" to a variable distance—it might be of about an inch up to about three inches or more—and the operation was most energetically carried on by the collection of maggots which I had under observation, which dispersed themselves in all directions, falling with an audible noise on the sheet of paper on which I was watching their movements.

On July 15th, two *puparia* or chrysalis cases were noticeable. These were cylindrical, but lessening to the head end, and somewhat smaller at the tail, which retained to some degree the spiny processes of its maggot condition. Length, little more than half that of the maggot when *quite* full grown and *quite* fully extended; colour bright chestnut, excepting towards the head extremity, which was rather darker in tint, as also (but to a very slight degree) the tip of the tail. A few of the collection of larvæ under observation were still at this time in quite young state.

On July 18th about thirteen puparia were formed, and there were larvæ of various sizes—from somewhat less than the sixteenth of an inch in length up to full growth—in the box with the piece of "skipper"-infested Ham.

The first specimen of the imago—that is, of the perfect fly of *P. casei*—was developed from my specimens on July 23rd.

The piece of Ham showed the great damage caused by the maggot workings well. This slice was about four inches long by two and a half broad, and a quarter of an inch thick, and in this the piece of fat overlying the meaty part (about an inch across at the widest part and two inches in length) showed distinct perforations caused by the maggots, and other injury caused by the attack, so that it was separable as a layer from the meat; but in the other parts of the slice I did not find any maggot-damage either to the solid meat or to the solid fat, only to the softish fatty part between the fat and lean attached by one side to the meat.

The following communication was sent me by my correspondents regarding Ham "skipper" infestation in course of some special correspondence, and contains serviceable information relatively to salt having *no* bad effects on the maggots, and other useful points of observation.

In regard to the enquiry whether the maggots were born in the Ham after the death of the pig—taking the word "born" here and also the word "germinate" in the second line of the communication to be equivalent to "hatch"—the maggots would hatch from eggs laid by the fly after the meat was salted. It appears to be quite proved that this Bacon and Cheese Fly will not lay eggs on fresh or unsalted meat, and, taking the liberty to alter one word of which the technical meaning is not quite certain in my correspondent's leading sentence, it is perfectly correct "these insects [hatch], live and thrive in salted meat."

I subjoin their serviceable communication verbatim:—

"July 18th, 1899.—There is, we think, no doubt but that these insects germinate, live, and thrive in salted meat. We think that in the late spring there were *no* flies nor maggots in our curing-room; since then and until lately we have had heaps of them—perhaps millions! These are *sweet-cured* Hams, and the saccharine matter may help on the germination and development. If *salt* does not favour them, it most certainly does not destroy them. It is common in Bacon-curing to find that maggots multiply and develop in the salt used in the curing of the Bacon, and that where there is no trace of taint. We think that these maggots came of flies which deposited their eggs in the meat *soon after slaughter*, and we found that the salt did not destroy their progeny. The Bacon keeps damp, even wet, from the salt and from the Bacon being stacked side upon side; but we are not conscious of the being of these maggots in the curing-room, as they show up *after* the Bacon has been smoked and dried. Are we wrong in supposing that these maggots were born there soon after the death of the Pig? The smoke of the drying-stove, with its heat, did not destroy them. Then, further, these *sweet* Hams are kept *after* cure in dry, well-aired

rooms. These small flies and maggots begin their life and work after the curing, and in course of the drying."

On Aug. 1st the following letter was sent me, which shows that some amount of remedial measure was being satisfactorily brought to bear on the infestation by the use of a fly powder:—

"I am happy to tell you we are finding that by a free use of a fly powder* we are clearing our store of a large number of insects. We still have much trouble with the cured Hams. . . . We find the mischief caused so soon after curing, that we are arranging to bag the Hams immediately they come from the curing-room, and dry the Ham and the bag together."—(Communication from Ham-curing Company.)

In the observations quoted previously a passage occurs regarding egg-laying of this fly:—"I have not been able to make it oviposit on fresh meat of any kind, nor does it seem able to breed upon that which is simply salted." . . .

Relatively to how far this latter point might be the case in broad-scale trade treatment (that is to say, whether the fly would not attack salt meat *unless also smoked*), I made some special enquiries from the Company, from which I received a good-sized sample of very thoroughly "hopper"-infested Ham, and was favoured by them with the information that their "*Hams were not smoked*," and suffered much more than the smoked Bacon. Their reply was as follows:—"With reference to the fly being attracted by smoked meat, we do not attach so much importance to the actual condition of the meat as to the condition of the atmosphere in which the meat is kept, and whether such is favourable to the fly or otherwise.

"Our Hams are not smoked, but sweet-cured and dried. It has always seemed to us that the peculiar aroma from these Hams has been attractive to the fly. We may say that in our business we have large quantities of smoked Bacon, but we do not find this suffers in anything like the same degree as the Hams. The fact that the flies do not breed so much in salted meat as in smoked is probably owing to the fact that the former is kept in cellars of low temperature."—(Sec. of Curing Co., referred to.)

The records of the method of attack of this fly to Ham and Bacon given in 'Insect Life,' vol. vi. (referred to in note, p 8, preceding), agree with what I was able to notice in the specimen sent to myself for examination. "The lean meat was never in any case penetrated, . . . nor was the solid fat much damaged. . . . Myriads of 'skippers' and puparia, in all stages of development, were found in the packages reported on, clustering round the bony ends of ham and shoulder, and in the *softer fat*, and oil-saturated folds of the canvas wrappers."

* Keating's Fly Powder might very likely be useful.—E. A. O.

The following notes on prevention and remedy of attack of P. casei to Bacon are given by Miss M. E. Murtfeldt in the paper in 'Insect Life,' vol. vi. No. 2, p. 175, referred to in note at p. 8, preceding. "When exposed to severe and protracted cold, larvæ, pupæ, and flies are killed. The flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon them, produces the same stupefying effect that it does upon other Diptera" [two-winged flies]. "The firm in whose behalf these investigations were undertaken informs me that in order to exclude the fly they screened all windows and doors with a twenty-four to the inch wire mesh.

"They also, early in the spring, thoroughly whitewashed and fumigated smoke-houses and store-rooms, using an admixture of carbolic acid in the whitewash, thus effectually sealing up or killing all hybernating individuals that might be lurking in these places."

In Bulletin No. 4, U.S.A. (referred to at p. 8, preceding) it is also mentioned "that close screening of the windows of pantries is advised to keep out the fly." Whether for preservation of Bacon or Cheese, such arrangements as may thoroughly prevent entrance of the flies are very important.

Piophilæ casei as a Cheese attack.—The first inquiry regarding this as a Cheese infestation was sent me on the 29th of March in last season from a farm in Shropshire, as follows :—

"We are troubled very much with a small fly that I never saw until last year all about the house. I make Cheshire Cheese, and the room is swarming with them now, and summer time; there are not any Cheeses in the room now, but flies are there. I perceived the air swarming with them. They are half the size of an ordinary fly, and I fancy they enter through the window when open."

A corroborative sample of flies was enclosed, with some further remarks as to the attack of the flies to the Cheese, and the great consequent mischief likewise, the Cheese being "fat." This point (that is, the richness of the Cheese), also the very great numbers of the flies, and also the point of their effecting their entrance through the window when open, are all matters for special notice connected with the infestation, and the latter very especially relatively to available methods of forestalling attack.

With regard to observation of jumping maggots in "fat Cheese," so far back as the year 1567, it is of interest to notice that in the 'History of the Northern Nations,' by Olaus Magnus, Archbishop of Upsal, printed at Basle in the year 1567, at p. 812, after an enumeration of various kinds of worms or grubs, it is mentioned that there is also another kind of grub which infests Cheese, leaping in the shape of a bow in fat Cheese, and which no cold destroys. The passage is as

follows: "Vermis deniq; aliis caseorum, saliens instar arcus in pinguibus caseis, qui nullo frigore interimitur."—(O. M.)*

No name is given to the infestation, and it can by no means be said that this ponderous and ancient volume is a safe guide in scientific or many other respects; but, taking the characteristic points of this maggot leaping in an arched form in Cheese, and also in "fat Cheese," it seems in all reasonable probability to be our widespread pest of the present day—*Piophilæ casei*, Linn.

On applying for information regarding Cheese Fly attacks to Mr. Richard P. Ward, Organising Secretary of the Cheshire County Council, he was good enough to procure the following observations for me from Miss Foster, Chief Instructress at the Dairy Institute at Worleston, where, in 1898, almost sixteen tons of Cheese were made by the students under her direction. Miss Foster kindly reported as follows:—

"The best remedies I know are thoroughly lime-washing the walls every year, painting all the woodwork, and cleaning the floors thoroughly with soft-soap; this prevents the eggs hatching out.

"At the very commencement of the fly season fly-papers and other fly-killers should be used, so as to destroy as many as possible. All damp straw should be moved, as moisture is necessary to the fly when depositing its eggs. All cracks in the Cheese should be filled at once with a mixture of flour, butter, and pepper. Of course the Cheese should be turned daily, and a careful watch kept for cracks and fly-deposits. If the flies have obtained an entrance into the Cheese, the best thing is to cut out the affected part, dust thoroughly with black pepper, refill with Cheese, and cover carefully with calico.

"The Cheese should be moved each week, and the floor and benches thoroughly scrubbed.

"Some people use lime to fill the cracks, but it destroys the colour of the Cheese. Old-fashioned people think that branches of alder and ivy hung in the room will drive away the flies, but I have proved this to be a fallacy. The great thing is to destroy the flies."

On July 12th Mr. Robert Challinor, Secretary of the Cheshire Dairy Farmers' Association, writing from 22, Old Bank Buildings, Chester, was good enough to give me the following remarks:—

"I am glad to say that there is very little complaint amongst our

* See 'Historia Olai Magni Gothi Archiepiscopi Upsalensis, de Gentium Septentrionalium variis conditionibus statibusque,' &c. Basileæ ex officina Henrici Petrina. M.D.LXVII. The Archbishop's special preface is dated a few years earlier from Rome: "Romæ 4 Nonas Januariæ Anno salutis partus M.D.L.V." The above extract is taken from the division on insects, Liber xxii. cap. viii.; and, as I am fortunate in possessing a copy of this rare old book, I have quoted the references at length, as sometimes they are variously given, presumably from their being taken from the various editions.—(E. A. O.)

dairymaids of the fly trouble. Where it does appear, certainly it creates loss and gives trouble, but if they are careful they can prevent it appearing; and if it is there they can get rid of it by scraping out the crack and filling it with flour or borax; but it is important that this should be done with as little delay as possible to prevent further mischief being done."—(R. C.)

Mr. Challinor further obliged me with a few notes from Cheesemakers, from which I give the following extracts without names of contributors:—

"Mrs. B says that she has rarely had any trouble with the fly. She has an idea that keeping the Cheese in a good sound condition and the room dark is a certain preventative.

"Mrs. C says that occasionally she has been troubled with the fly, but its visit has always been traced to neglect in leaving some crack or opening in the Cheese exposed.

"Mr. D says that in most cases the Cheese leave the farmer's room before the flies can give much trouble. In his opinion, to find the effects of the work of the fly in its worst form we should follow the Cheese to the warehouse or the place where they are stored before they are distributed for consumption. The dealers or factors I know to have suffered severely on account of the fly developing in the Cheese, very often through a little neglect on their part in not giving attention to the places where they have been bored for tasting; but I believe that most of them now make one of their men responsible to see that they have the attention needed.

"*Hot steam.*—I should think that hot steam would destroy either maggot or fly, but few farmers could manage this. No boiler or other convenience at their disposal."

The above notes from "B," "C," and "D" contributed by Mr. Robert Challinor.

The remarks relatively to "hot steam" are in reply to some inquiries of my own as to how far this application might be considered serviceable where steam power *was* available. It is now a good many years since I was consulted as to some practicable method of getting rid of this Cheese Fly infestation on a large scale, and, as steam power in this instance was at hand, I suggested turning on hot steam by the hose into the Cheese-room or store, with the view of killing maggots, chrysalids, and flies—in fact, destroying the infestation in any stage in which it might be present by *scalding it out*. As matter of course, the store-room was cleared of Cheese before the current of hot steam was applied. This was several years ago, and, not being working on stored material of this kind at the time, I did not keep the notes, so I am unable to give report of results verbatim, but I understood that the treatment was successful.

Continuing the observations of Cheese Fly habits and prevention. On June 14th I was favoured by the following notes from Mr. D. E. Byrd, of Spurstow Hall, Tarporley, Cheshire:—

“Of course prevention is better than cure, and that, we carry out by keeping the Cheese-room as dark as possible. Of late years we have put calico caps on the Cheese, as well as the binders, which effectually keep all flies, beetles, &c., from the Cheese; but, should any Cheese be affected, flour and pepper is put in the affected part, which will probably kill the maggot, and the crack can be filled with soft Cheese.”—(D. E. B.)

In a subsequent letter (on June 28rd) Mr. Byrd mentioned: “One of our leading Cheese makers always uses quick-lime as a cure for the maggot in Cheese.”

The following observations from a leading cream Cheese maker in the United States, quoted from ‘Insect Life,’ vol. vi., previously referred to, draw attention to treatment requisite to prevent entrance of the flies through open windows, and measures for catching such as may be found present:—

“We are always somewhat troubled with the Cheese Flies in summer. To keep them out of our storerooms we cover the windows with light domestic, as they will go through the ordinary wire-screen; but, as there will always be more or less of them in the rooms, we have the brown fly-paper in water always on hand, which keeps them pretty well in check.”

Another note immediately following from a large Cheese manufacturer mentions that he “depends mainly upon fine screens to keep out the fly, and also darkens his storerooms; has each Cheese rubbed hard each morning; uses no chemicals but a Cheese grease that contains some rosin which gives a hard coating.”

PREVENTION AND REMEDIES.—The various observations show that, where the infestation is neglected, the fly multiplies enormously, and the losses from maggot attack whether to Cheese or Bacon are great, but that preventive treatment reduces these losses to an immaterial amount. In the preceding pages the notes of treatment are given, together with those of the habits of the pest sent accompanying; but for convenience of reference I give below the methods of prevention advised, classed under headings, and as shortly as possible.

Prevention of fly presence.—To prevent fly entrance, it is recommended to exclude this *P. casei* by screening all doors and windows by a twenty-four to the inch wire mesh. If the mesh of the wire-screen is not small enough to keep them out, then similar use of light thin cloth is advised; this of course to be so fixed that the flies may not

get in at the edges.* The brown fly-paper used by laying in water is serviceable in broadscale treatment, and any other fly-papers or fly-killers which answer these purposes are trustworthily recommended. I do not find that fumigation is much used with us, but in U.S.A. practice it is noted that the flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon the flies, stupefies them.† The Bacon Company whose notes I give at pp. 12, 18, preceding found a fly powder of great use.

The flies are not active at night, and to make the Cheese-rooms as dark as possible is one method with us of lessening attack; but the success of this would probably depend on the extent of the darkening, for if this is only partial the fly can still work.

Remedial and preventive measures to destroy infestation in maggot or other stage in stores or Cheese-rooms.—Thorough fumigation early in the spring, and also thorough whitewashing, using an addition of carbolic acid, “thus effectually sealing up or killing all hibernating individuals that might be lurking in these places” (M. E. M.).‡ Every crack should be carefully looked to which may be serving for a sheltering place from which the pest might wake up in fly, or develop out of chrysalis state, with the first warm weather.

Shelves should be kept carefully cleaned; floor and benches also thoroughly scrubbed, and (*wherever it can be used*) kerosene emulsion, or its British counterpart (soft-soap wash with a little paraffin or other mineral oil stirred into it), should be liberally scrubbed in. Careful attention to such measures as the above should be kept up during the whole of the season whilst the fly is active. As the maggot by no means certainly turns to chrysalis state in its feeding ground—indeed, in some cases certainly it seeks a drier locality—it is necessary to take such measures as may destroy such as are scattered, or sheltered near the food.

Where the stores can be emptied, and steam-power is present, it

* NOTE.—*Where do these flies come from?* It is plain from treatment to exclude them being a regular part of preventive treatment, that this entrance from outside is a part of the well-established life-history, and if we knew where they came from it might help us much. Do they propagate more than has been traced out at present in decaying filth? Taschenberg, in his *Piophilæ casei*, ‘Praktische Insektenkunde,’ pt. iv. pp. 141, 142, mentions that they were found by Germar to breed in human excrementitious matter when half decayed.

† Pyrethrum powder is procurable in this country under the name of Persian powder, and if fresh acts trustworthily; but probably it is well to see whether after a time the flies would revive, and if so to sweep them up and destroy them. The only objection mentioned to the use of the sulphur is that it was found to give a streaked look to the wash used by the firm (U.S.A.), who especially reported on it.

‡ It should be borne in mind that crannies in roofs and ceilings may shelter the flies as effectually as those in walls or floors.

might prove of use to try the effect of turning in hot steam (see p. 16, preceding); but it would assuredly be desirable, although I do not see this point brought forward, in the case of the scrubbings and washings with water, to use this at as great a heat as could be managed by the workers; and where scalding soft-soap wash could be "swilled" along floors, it would be pretty sure to make an end of all infestation that it touched.

Treatment to preserve material from attack, or to get rid of infestation when present.—One plan which is noted as having been found effectual after several years' trials is to put calico caps on the Cheese, as well as the binders. This keeps off Cheese vermin generally, as flies, beetles, &c.

Preservation of Hams from attack by securing them in bags is alluded to from various quarters, but I do not find any working recipe for this treatment, except mention in one instance that the Hams were rubbed with black pepper before putting them in the bags. It is plain that the advice given in regard to bagging Hams to protect them from the "Ham Beetle" is equally applicable for Ham *Fly* in respect of the material used being strong enough for there to be no risk of holes being broken in it by accidental rough treatment. Also holes gnawed by mice would require to be looked for, and also care would need to be taken that the material used, whether canvas or otherwise, was such as would allow no chance of maggots laid by the flies outside the bags making their way through to the cured meat within. The egg of *P. casei* is only about one-twenty-fifth part of an inch in length, and about a quarter of that measure in width—that is to say, about one-hundredth part of an inch in width; and the young "hopper" maggots on their first hatching from an egg of the above-mentioned size might presumably make their way pretty easily through material not carefully chosen to allow of no passage. Bags afford sheltering places in their folds for the infestation, and up to date of observations some application which might be deterrent to fly and maggot presence, and non-injurious to the Ham within the bag, seems to be a great desideratum.

To clear eggs from the Cheeses before the maggots hatch, it is recommended that each Cheese should be rubbed hard every morning—one U.S.A. observer notes, "We usually go through the rooms twice a day and look for eggs"; also the use of a Cheese-grease that contains some rosin, and which gives a hard coating, is advised.

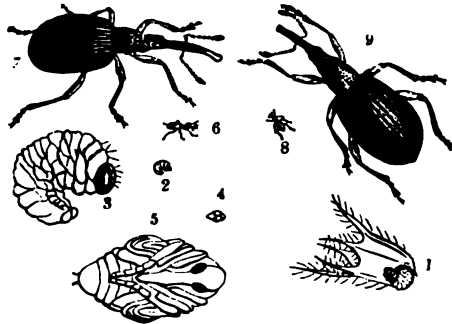
Portions of Cheese and Ham that are found to be attacked should be cut out, and as soon as possible after observation; and, with regard to Cheese, it is recommended that, after cutting out the piece, a thorough dusting of black pepper should be given, and the cavity re-filled with Cheese, and covered carefully with calico. A careful watch

should be kept for cracks, and all cracks in the Cheese should be filled at once with a mixture of flour, butter, and pepper. The Cheese should be turned daily, and moved each week.

Another contributor mentions flour and borax as a mixture to be used after scraping out the infested crack.

CLOVER.

PEAR-SHAPED WEEVILS—**Purple Clover Weevil**, *Apion apricans*, Herbst. (= *A. fagi*, Kirby; *A. flavifemoratum*, Kirby); *Apion assimile*, Kirby (? var. of above). **Clover-head Weevil**, *Apion trifolii*, Linn.



6, 7, *Apion apricans*; 2-5, maggot and pupa; 8, 9, *A. assimile*—all natural size and magnified; 1, maggot feeding.

Clover crops, and most especially those of Red or Purple Clover (*Trifolium pratense*), suffer much from time to time from the depredations of a few species of *Apion*, popularly known as "Pear-shaped Weevils." These beetles are of very small size, from rather less to rather more than a line in length, somewhat oval in shape, and furnished with a long and slender proboscis, more or less curved as the case may be, giving to the beetles (when examined by a magnifier sufficiently powerful to show the form) a likeness in shape to a miniature Pear, together with its stalk—whence the popular name of Pear-shaped Weevils.

There are many species of this genus in Britain; as many as about seventy-five are recorded as present, which for convenience of reference are divided into groups; and of these Group 6, of which the upper surface is black, the legs wholly or in part red, and the

pubescence very slight or absent, are chiefly found on species of *Trifolium*.*

The three kinds most injurious to Red or Purple Clover (*Trifolium pratense*) are, first, *Apion apricans*, Herbst., known also as *A. fagi*, Kirby, and *A. flavifemoratum*, Kirby; second, *Apion assimile*, Kirby, which formerly stood as a distinct species, but which now, from its very slight variations from the species above mentioned, is considered by some of our leading coleopterists should only take rank as a variety; and third, *Apion trifolii*, Linn., which is rather smaller than *apricans*, and has the proboscis much less curved.

These kinds, so far as I have seen from specimens sent, and also as noted by Dr. Taschenberg,† are similar in their life-history; and as the above-named kinds or varieties may all be present together, it is almost impossible on the broad scale of field cultivation to say which of the kinds may be doing mischief, beyond those of which specimens are sent for identification.

The life-history of the Purple or Red Clover Weevil, which it appears may be taken as that also of *assimile* and *trifolii*, may be given shortly as follows. The beetles live through the winter, and when the Clover has run up to blossom the female weevils lay their eggs in the flowering-heads. The maggots which hatch from these eggs pass through the calyx to the forming seed, on which they feed. They are stated to make their way into the seed and feed on it until it is consumed; then they make their way out, and turn to chrysalids in the flower-head amongst the dying blossoms. (In my own examinations I have found little maggots free in the flower-heads.) These are little fleshy larvæ of the shape figured at p. 20, with rather horny heads, and scarcely a line in length, and legless. They usually lie somewhat curved together.

The chrysalids may develop into weevils in about a fortnight in summer, and thus furnish a second brood, of which the beetles attack the Clover leafage, sometimes to a very injurious extent, and when the flower-heads of the second crop of Clover are sufficiently advanced for infestation, set attack on foot precisely as on the earlier crop, excepting that it may remain in chrysalis state throughout the winter.

The following detailed description of the larva and pupa of *Apion apricans* by Mons. Guérin-Méneville is given for service where minute reference is required, to which is added some further description of the

* In many points of technical description of characteristic differences between the beetles, and also with regard to considerations of *A. assimile*, Kirby, being now considered by various qualified writers as being not a separate species, but one with *A. apricans*, I am much indebted to information given in 'The Coleoptera of the British Islands,' vol. v. pp. 145 and 148, 149, by the Rev. Canon W. Fowler, Secretary of the Entomological Society of London.

† 'Praktische Insektenkunde,' pt. ii. p. 181.

same species under the synonym of *fagi*, by Georg Ritter von Frauenfeld, which gives a few additional points useful for identification:—

"*Apion apricans*, Schöenh.*—The larva is scarcely two millimètres in length, thick, arched, and slightly resembling the 'white grub' of the Cockchafer in shape. The head is reddish, a little horny in texture, and armed with two strong mandibles. On each side and near the insertion of the mandible, a very small smooth eye, and below this a small articulated style, which represents the antenna. The three first segments of the body, those of the thorax, are sufficiently well marked; they do not bear feet, properly so called, but each has beneath it two fleshy tubercles, which certainly take their place. The segments of the abdomen are not well determined, beneath they are mamillated; the body is entirely glabrous, without colouring. . . .

"The chrysalis is nearly as large as the larva, white, rather soft. The head is bent downwards; the wings, elytra, and feet are folded on the sides and beneath; the third pair of feet is separated from the others by the elytra, and the antennæ are not elbowed, and are laid by the head with an upward direction ('*en se dirigeant en haut*').

"The larva lives at the base of the calyx of the flowers of the common Trefoil (*Trifolium pratense*). It gnaws the grain which is to be found at this spot, and pierces a hole in the side of the flower, by which to escape from it, and changes to the chrysalis amongst the various flowers of the flower-head."

In the short descriptions of the larva and pupa of the above species (*A. apricans*), given under the synonym of *A. fagi*, L., in the 'Zoologische Miscellen' of G. von Frauenfeld,† especial mention is made of the "extraordinarily long" proboscis of the pupa, which reaches far along the body, and is but little covered by the elytra. The other details are so similar that they do not require repetition.

The above observations of the life-history and early stages of *A. apricans* are given in detail, as, so far as is known, these appear to be so similar in the three kinds of weevil under consideration as to be indistinguishable to all ordinary observers; and those of *A. apricans* have been the most fully described. Similarly with regard to these three species, when developed to perfect, that is beetle, state, it is impossible for all but skilled observers to identify them as distinct species trustworthily without some special guidance; and as it is to

* 'Annales de la Société Entomologique de France,' deuxième série, tome premier, p. 66: "Notice sur les Métamorphoses de l'*Apion apricans*," par M. F. E. Guérin-Méneville; 15 Février, 1843. So far as I am aware, this description, although published so long ago, is still the fullest and best that we possess. The paper is illustrated, but I omit references to the figures, as it was not necessary to copy the plate.—E. A. O.

† Georg Ritter von Frauenfeld in 'Verhandlungen der K.K. Zool.-botan. Gesellschaft in Wien,' xvi. Band.

a great degree by characteristic differences from *A. apricans* or *A. fagi* that they may be distinguished, it has seemed desirable to give one authoritative description of this species verbatim, and this I accordingly quote from Canon Fowler's work on British beetles referred to below.*

The full description of the beetle of *A. apricans* is:—"Black, glabrous, rather shining; forehead rugosely punctured, rostrum long and slender, slightly curved; antennæ black, with base reddish; forehead rugosely punctured; thorax oblong, oval-cylindrical, rather closely and distinctly and regularly punctured, with a central channel behind; elytra obovate, with strong punctured striæ, interstices rather broad; legs black, with all the femora and the anterior tibiæ reddish testaceous. Length 2-2½ mm.

"Female with the rostrum longer than in male, and the elytra deflexed and callose behind."

The usually received differences of *assimile* from *apricans* are stated by the same writer to be as given by Walton (in Ann. and Mag. Nat. Hist. 1844, p. 87), that *A. assimile* has the rostrum in both sexes *distinctly more curved*, and, in the male, attenuated in front; also it has the basal joints of the antennæ *dull piceous*, and the thorax *closely punctuated, with the punctures confluent*; also *A. assimile* is smaller than *A. apricans*.

Apion trifolii, it is stated, may be distinguished from *A. apricans* by having the *anterior trochanters pitchy*, and the *four posterior trochanters black*, whereas in *apricans* they are all rufous; the antennæ are relatively shorter, and are *entirely black*; the rostrum is very little curved, and the general form shorter; the average size also smaller. Length 1½-2 mm. (See 'Coleoptera of British Islands,' vol. v. p. 149.)

Apion trifolii.—Towards the end of June in the past season I received, per favour of the editor of the 'Farmer and Stockbreeder,' † some specimens of Clover-heads from near Ampthill, which were infested by small maggots; the attack, so far as could be judged in its then condition, being of *Apion apricans*, or one of its near allies (see preceding descriptions); and shortly after some more Clover-heads were forwarded me from the same locality containing some of the developed weevils. These proved on investigation to be of *Apion trifolii*, Linn., and though this is often found with the two above-named kinds, on this occasion all the eleven specimens sent proved to be *trifolii*.‡

The only other occasion on which I have had specimens sent me which were certainly of this species was in the beginning of September

* 'Coleoptera of the British Islands,' vol. v. p. 148, by the Rev. Canon Fowler.

† See number for June 26th, 1899, p. 954, col. 2.

‡ As I wished to be perfectly certain of the kind, I availed myself of the courtesy of Mr. O. E. Janson, F.E.S., for specific investigation.

in the year 1886, when heads of Purple Clover infested by Clover Weevil were sent from Gireleston, West Buckland, Somerset, where the maggots were doing much harm to seeding Clover. About fifty acres (which were being saved for seed) were noticed to be infested by small white maggots, which were feeding at the base of the florets, and it was stated that every field of Clover in that neighbourhood was similarly attacked.

At the same time a similar attack on seeding Clover was reported from the neighbourhood of Enmore Park, Bridgwater. In this instance it was stated that in each head there were small white maggots, generally five or six in number; and that whole crops had been destroyed, the observer having found "scarcely a single plant un-attacked."

Here also I found *Apion* maggots in the Clover-heads sent; little fleshy white maggots, with brown heads, of the shape figured at 2, and 8, magnified, p. 20. The maggot was of the characteristic form of *Apion* larvæ, that is, legless, but with the front segments somewhat enlarged below, and tubercled so as to aid in power of progression. The maggots lay also, as customary, somewhat curved together.

After careful examination of the Somersetshire specimens, especially of the very minute portion of the leg-joint called the *trochanter*, I am inclined to think that both *A. apricans* and *A. trifolii* were present.

The *trochanter* is an exceedingly small portion of the leg, placed immediately above the *femur*, or thigh, and intermediate between the *femur* and another small joint or portion called the *coxa*, which is affixed to the body of the beetle. The entire leg thus consists of *coxa*; *trochanter*; *femur*, or thigh; *tibia*, or shank; and *tarsus*, or foot. And *A. trifolii* may be distinguished from *A. apricans* (see also preceding page) "by having the anterior trochanters pitchy, and the four posterior trochanters black, whereas in the latter species they are all rufous."*

PREVENTION AND REMEDY.—Some leading points as to these may be found by observation of the broad scale infestations of the weevils themselves, independently of the maggot-attacks in the flower-heads.

In a record before me† an observation is given of the case of a field of Clover twice mown, when (in September) the part of the field near the stack had been lately attacked by a small black weevil, which advanced in a semicircle, leaving only the fibre. It was estimated that on some of the leaves there were as many as, or more than, a hundred weevils.

In another observation quoted in the same paper from the report

* See 'British Coleoptera,' vol. v. p. 149, by Canon Fowler.

† See Curtis's 'Farm Insects,' p. 477.

of M. Herpin, he mentions that his Clover was mown in full flower, and in about ten or twelve days, or rather less, after housing the Clover in the granary, a great quantity of *Apions* were perceived moving in all directions upon the wall of the building, and making their way towards the outside. The escape of these *Apions* continued for eight or ten days.*

These observations point to a good broadscale method of preventing or forestalling recurrence of attack by mowing the Clover before the flower-heads are sufficiently advanced to have become the nurseries of any great quantities of maggots. The *premature* and *partial* maturity of the florets in the flower-heads is one sign of presence of the maggots, and mowing on the first symptoms of this being noticed is one measure of prevention of a good proportion of coming mischief in the shape of development of beetles, which would lay their eggs either, as the case might be, in the flower-heads of the crop immediately following in summer, or after hibernation in those of the first crop of the following season.†

Any measures, such as cutting, or feeding the crop off early, before the heads have advanced to the condition at which they give shelter to the weevils for egg-laying, are obviously beneficial; and so likewise (where there is any reason to apprehend that infestation is likely to occur) is avoiding Clover crops remaining for more than two years in succession on the same ground.

Where the beetles are observed in the great numbers mentioned at p. 24, as leaving the stack and making a regular advance in a semi-circle, destroying the Clover leafage in their march, it would be well worth while to experiment as to getting rid of them by the use of some of the various insecticides which are now available.

If circumstances allowed the space round the stack to be thoroughly secured by hurdles or otherwise, so that there was no *possibility* of the farm stock or ground game getting at the Clover, and there was no reasonable probability of poultry flying over the fence, the use of Paris-green would be exceedingly likely to be of service. The special use of the application would be that it might be presumed that (as in all other cases of application of this *poison*) the beetles would eat the sprayed leafage and *be killed*. Kerosine emulsion or soft-soap wash with paraffin mixed in it, or gas-lime applied as a dry dressing, would not act so certainly, because, although any of them might very likely protect the Clover plants on which they were thrown, they would have no effect in preventing the *Apions* taking flight from the stack in which they were developed. The *Apion apricans* have very powerful wings.

* See 'Extrait des Mémoires de la Soc. Roy. et Centrale d'Agric.' année 1842.

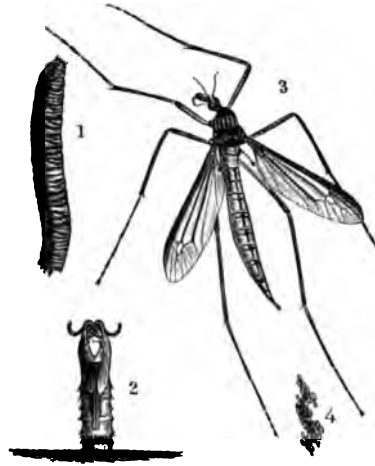
† This treatment of course is *not* applicable where the Clover is being grown for seed.

More observations of the above kinds of Clover flower-head attacks, with notes of measures found serviceable for their prevention, would be very acceptable for general farm use.

CORN AND GRASS.

Cabbage Daddy Longlegs. *Tipula oleracea*, Linn.

Spotted or Yellow Daddy Longlegs. *Tipula maculosa*, Hoffm.;
Pachyrhina maculosa, Hoffm. and Meigen.*



TIPULA OLERACEA.—Fly, larva, and pupa standing upright in the ground as before escape of fly.

The "Leather Jacket" grubs, from which are produced the swarms of large, somewhat gnat-like, two-winged, and long-legged flies, commonly known as "Daddy Longlegs," or "Crane Flies," are only too well known by reason of the mischief which they cause every year at the roots of grass, of corn, and of many other kinds, both of field and garden crops, by gnawing them just below the surface of the ground, and thus more or less injuring the attacked plants, or destroying them totally, as the case may be.

* In the following notes some of the observations refer to the presence of *Tipula* larvæ in pasture land, others to presence at Strawberry roots; but as they could not conveniently be separated, and as one of the observations refers their presence at both crops, I have inserted them under the heading "Corn and Grass" as the most well-known locality, but referring back to this heading from that of "Strawberry."

Of these *Tipulæ*, and their near allies the *Pachyrhina*, there are more than forty species to be found in this country; but of these there appear to be only three kinds of which the larvæ or maggots are looked on as year by year doing serious mischief as root pests. These are, respectively, the "Cabbage Daddy Longlegs" (*Tipula oleracea*); the "Marsh Daddy Longlegs" (*Tipula paludosa*), which is stated by Curtis to be so closely allied to the foregoing species that it is generally confounded with it, and is similar to it in habits and economy; and, thirdly, the "Spotted" or "Yellow" Daddy Longlegs (*Tipula (Pachyrhina) maculosa*), a much smaller kind, but also very mischievous.

With regard to the habits and means of prevention of the so-called Daddy Longlegs attacks, it appears as if everything had been recorded that could be needed for general service; * but I insert some further observations on the infestation, as in the past season I received some special contributions which enabled me to identify *T. oleracea* as doing much mischief in dry parts of hill pasture in North Britain, and the smaller kind, the spotted *Tipula maculosa*, as injurious in Strawberry beds; and also received some few additional remarks on remedial treatment.

The ashy or greyish general appearance of the Cabbage *Tipula* is well known; and the marsh kind, *T. paludosa*, for all practical purposes, may be described as very similar to it, excepting in the matter of the wings as well as the legs of the female being shorter in this species than in *T. oleracea*. The spotted kind, *T. maculosa*, is much smaller, the wings being only about an inch in expanse (whereas those of *oleracea* are from an inch and a half to two inches), and the colour is yellow spotted with black; the wings are yellowish, with yellow fore edge; and the long slender legs ochreous, with feet and tips of thighs and shanks black.

The only means, however, of knowing which kind it is of the above-mentioned species which is causing mischief is by examination of the maggots, and it is so very rarely that observations of attack on a large scale, with specimens accompanying, are available, that I give notes of mention of reports sent of presence of *T. oleracea* at grass roots of dry hill pastures, and of *T. maculosa* at Strawberry roots, as well as of both the above-mentioned species, also at Strawberry roots.†

* Vide references in General Index to preceding Series of Annual Reports, from 1877 to 1898 inclusive, by B. Newstead, F.E.S., with Preface by writer. Simpkin & Co., Stationer's Hall Court, E.C. Price 1s. 6d.

† I have continued use of the popular name of "Daddy Longlegs" for the flies, as, though certainly very trivial, it is better known generally than that of "Crane Fly."

Tipula maculosa is now known scientifically as *Pachyrhina maculosa*. The genus *Pachyrhina* is not very strictly limited; but the rust-yellow and sulphur yellow flies of this genus are distinguishable from the rust-yellow flies of the genus

The maggots of *T. oleracea* are about an inch in length when full-grown, cylindrical, legless, and about the thickness of a goose-quill, with little dark or black heads furnished with minute horns and strong jaws, which heads they can retract or protrude at pleasure.

The maggots of *T. maculosa* are very similar to the above in general appearance, excepting in being smaller, only about three-quarters of an inch in length, and the thickness of a large crow's-quill; and in both instances the colour is of some shade of earthy grey. But the two kinds may be distinguished (with the help of a magnifier) by the arrangement of tubercles, or fleshy protuberances, present at the *edge of the truncated tail segment*. In the case of *oleracea* the edge above is furnished with *four* fleshy tubercles, more or less pointed, and below are two more. In the case of *maculosa* the truncated tail is furnished above with *two spreading hooks and two short teeth between them*, and below with two tubercles. There are also two fleshy protuberances capable of being protruded or withdrawn.

The maggot of *oleracea* changes to the chrysalis in the earth, and presently, by means of transverse rows of spines, works itself through the surface of the ground, till about half the length is exposed (see figure, p. 26), and then by means of cracking open the horny covering the developed fly within makes its escape. This change may take place from the beginning of August (or even earlier) or during autumn, and some come out in spring. The larvæ, *vide* p. 29, may sometimes be found doing great mischief as early as the middle of March.

I am not aware of there being any difference worth mentioning in the life-history of *maculosa* either in maggot or chrysalis state from that of *oleracea*.

On July 7th the following communication was sent me by Mr. Robert Scott (shepherd), from Phaupknowe (? Newcastleton, R. S. O., Roxburghshire), N.B. It is very short, but still of a good deal of interest, from its observation of the great amount of damage done by the grubs to the dry parts of hill pastures; and also the benefit formerly received from crows (*anglice*, rooks) in keeping down the insect pest, which birds, however, were then being destroyed to a hurtful extent. Mr. Scott observed:—

“I take the liberty of enclosing to you in a box a sample of the caterpillar which is doing great damage to the dry parts of hill pasture on some farms in Liddesdale; it leaves the part quite bare. . . . The crows used to devour it greedily, but some parties in this district

Tipula by some minute differences in the form of the head, of the first article of the antennæ, and of the second posterior cell of the wings, for which see descriptions by Meigen, Macquart, Schiner, &c. But for ordinary working purposes the flies are sufficiently distinguishable by their shining bright yellow colour and black spots.

have commenced a crusade against the crows and destroyed large numbers, so am afraid we will not get much help this year from them."—(J. S.)

I examined the sample sent carefully, and found no difference between it and the characteristic form of the larva of *T. oleracea*.

On May 30th the following communication was sent me by Mr. Denis Best, from Holt Castle, near Worcester, regarding damage caused to his young Strawberry plants by a grub of which he enclosed specimens, and which proved on examination to be larvæ of the Yellow or Spotted Daddy Longlegs (*T. maculosa*). Mr. Best remarked:—

"About two months ago I planted a piece of land, about five acres, with Stirling Castle Strawberry-runners. The weather since planting has been very much in their favour. I dressed the land with from twenty-five to thirty tons of stable manure per acre. About a fortnight ago I noticed that a good many of the young plants were dying off, and on closer inspection I found a small grub at the roots of the Strawberry-runners. If I cannot stop the roots being taken, I am afraid my plant of Strawberries on this piece of land will be destroyed. I am sending you with this one or two of the grubs."—(D. B.)

The specimens sent were from about one-fourth or three-eighths of an inch to rather over half an inch in length, and from the formation of the truncated tail segment, which was furnished with two spreading hook-like tubercles and two short teeth between them, appeared to be certainly larvæ of *T. maculosa*.

Early in March, by favour of Messrs. Laxton, of Bedford, a letter was forwarded to me from a Strawberry grower on a large scale in North Wales, whose name I do not give for obvious business reasons, requesting information as to how to prevent the ravages of a dark coloured caterpillar-like grub which was cutting the roots, and feeding in the hearts of the Strawberry plants.

On March 21st, according to my request, our inquirer forwarded to me samples of the "grubs or caterpillars," which he mentioned as having been causing great destruction in his Strawberry beds. These proved to be *Tipula* larvæ (Daddy Longlegs grubs) of various sizes, some of them apparently of *T. oleracea*, the Cabbage kind, and some with power of protruding tubercles at the side of the truncated caudal extremity were *T. maculosa*. Mr. — mentioned:—

"My Strawberries are infested with the caterpillars now" [that is, at time of writing, March 21st, which is a point worth noting for practical consideration.—E. A. O.]. "Their action is to cut the roots of the plants and eat into the heart of them. When they have quite killed a plant, the caterpillars appear to go off to another plant, which is alive. It is rather strange that the three years' old plants are those chiefly affected. We see little damage done to the plants one and two

years' old. . . . Last summer we observed great numbers of this grub in the corn fields in this neighbourhood."

On May 6th, after some further communication, my correspondent wrote me the following remarks, which it will be seen embody in them some useful suggestions as to use of nitrate of soda. After some preliminary observations he wrote :—

"Having 85,000 of the three-year old Strawberry plants to deal with this year, I have come to the conclusion that the best plan is to try the nitrate of soda.

"I have been in communication with Dr. Bernard Dyer, for I wished to know how much nitrate I could use without injuring the plants. He has advised me to use $\frac{3}{4}$ oz. the square yard, putting it in equal quantities round the crowns of the plants. This is at the rate of 2 cwt. to the acre, and we are using it in powder. The first shower of rain will carry it all down. . . . To apply in a state of solution would be great labour and rather dangerous, for those employed in the work could not so well ascertain what amount they were really giving to each plant. . . . I propose next autumn, when these three-year old plants are taken up, sowing salt at the rate of 12 cwt. to the acre, and then planting the ground next spring. Salt at the rate of 12 cwt. to the acre will, as we know, kill any weed and Couch-grass, surely it will also kill the grub unless they go down away from it."

Observations were given of attack *in summer* to a very destructive extent by *white grubs*, apparently *Otiorhynchus* or weevil larvæ, presumably of one of the kinds which are frequently injurious to garden fruit crops by feeding at the roots in grub state, and at the leaves and soft shoots in beetle condition; but these notes I have carefully separated from those referring to the Daddy Longlegs grubs.

My correspondent promised me a report as to effect of the application of the nitrate of soda, and on November 8rd was good enough to send me the following information :—

"The nitrate of soda was applied during the months of April and May to about 85,000 Strawberry plants; this was carried out in accordance with instructions kindly given to me by Dr. Bernard Dyer. An examination of the roots of the plants in June and July showed that there were but few grubs of the Crane Fly present, but immense numbers of the beetle grubs. The application of the nitrate of soda did not in the slightest degree check the ravages of the grub. The crop was a failure, owing to the fact that the plants were almost separated from the ground, the grub having cut nearly all the small roots, and eaten into the heart of the plants as well. I marked plots of plants which did not receive any nitrate of soda. There was no difference between the plants which received it and those which did not.

"I noticed also that there was no extra leaf growth in the plants receiving the nitrate of soda. This was rather strange, because nitrate of soda increases the leaf growth very much. I can only account for it in this way,—after the application of the nitrate of soda we had very heavy falls of rain several times, and I think the nitrate of soda was washed away before the plants had derived any benefit. Our soil here is very light and porous, and I have several times seen nitrate of soda applied to our corn crops, and *in a very wet time no good whatever was derived from it.*"* Here my correspondent made some observations on the likelihood of sulphate of ammonia being more serviceable on such a porous soil on account of being less soluble than the nitrate of soda.

The above report, though by no means satisfactory in the point of view hoped for (and consequently adding to the losses of my correspondent, instead of lessening them), is valuable, and deserves careful attention in several of its details. Firstly, it did *not* induce a vigorous growth, which, where circumstances allow, is *the great reason for application* of nitrate of soda. Secondly, though only a few of the Daddy Longlegs grubs were found present in June and July, it is by no means certain that we owed this absence to the nitrate. We have no *evidence* either way; that is, the Daddy Longlegs grubs, to kill which it was applied in April and May, may have been killed, or they may (by June and July) have changed to fly state and taken flight. Thirdly, the application had done no harm to the white grubs, distinguished especially as beetle grubs, which, from the specimens sent me, I had found to be weevil, and apparently one of the very common kinds of *Otiorhynchus* grubs, which are very injurious at plant roots, and in this instance a bad attack observed to occur in summer.

The cause of the failure is attributed, so far as non-stimulating the plant growth, to great rainfall, and probably this is perfectly correct; and the observation that similar failure of effects had been noticed when applied to corn crops in a very wet time confirms the view, and is valuable in itself. Therefore, as giving the reason of failure of what is usually a trustworthy remedy, I give my correspondent's notes *in extenso*, as valuable both for crop and fruit growers.

PREVENTION AND REMEDIES.—These have been entered on in my previous Annual Reports so very fully that I only now repeat some of the main points or general principles of prevention.

With corn and grass crops a fertilizing application which will keep up the strength of the plants that are not hopelessly injured is what is most needed, and if at the same time the application is one injurious or obnoxious to the larva it is all the better.

* The italics are mine, to draw attention to observation of great fall of rain neutralizing the effect of the nitrate of soda, as this is important.

Applications that have been found to answer as a dressing, or in bringing crops through bad attack are,—guano; guano and salt mixed at the rate of 4 cwt. per acre; also guano $1\frac{1}{2}$ cwt., salt 2 cwt., kainite and superphosphate each 1 cwt. per acre.

Nitrates of soda acts well, as being a rapid fertilizer, and also obnoxious to the grub; and has been reported as having thoroughly good results, given at the rate of 1 cwt. the acre, to Barley when just above ground, on badly grub-infested land. A mixture of nitrate of soda and salt has proved useful, applied at the rate of rather more than 8 cwt. of salt and rather less than 1 cwt. of nitrate per acre, after rolling with a Cambridge roller, and harrowing. But in whatever way applied, nitrate of soda, or any other good fertilizer which will act at once, if melted and driven down by rain, has been found to have a good effect, unless (see p. 31) the rainfall is so great as to wash the fertilizer away.

Salt alone, applied as a remedial dressing where the grub was present, has failed in many cases to do good. In special experiments it has been found that, applied at a rate which killed the plants, salt had no effect on the grubs, except to drive them down for a time to a depth beyond its influence. But as a *preventive* dressing to ley-land before ploughing up, it has been found highly serviceable. Salt at the rate of from 5 to 12 cwt. applied before breaking up, or lime and salt mixed, would probably do much good. A heavy dressing of salt which would kill Grass, Couch-grass, or surface herbage before ploughing in would do no harm in this way, and destroy much shelter for this, as well as other insect vermin; and any of the methods of treatment or chemical applications which are known to be of use as preventives of Wireworm attack would also be of service.

Gas-lime applied in caustic state so as to act first as a destroyer of plant life and insect vermin on the surface of the land, and (after proper exposure to the air) as a safe and serviceable manure, is doubly useful. This may be given at a rate of two tons per acre, and should be applied by being spread evenly on grass-land before breaking up, or on stubble, or other land as required, and left exposed to the air for at least three or four weeks before being ploughed in. Thus a portion of the constituents, which at first do good by their poisonous nature, become changed by the action of the air to sulphate of lime, or gypsum, as manure serviceable on many soils.

Mechanical measures such as compress the ground and so prevent the larvæ "travelling" are of use; and so are the opposite methods of treatment, such as hoeing, harrowing, &c., which act by throwing the earth open and disturbing the grubs and throwing them open to bird attack. But what is commonly most needed is preventive treatment to the ground applied well beforehand.

"Hessian Fly." *Cecidomyia destructor*, Say.



CECIDOMYIA DESTRUCTOR, Hessian Fly, nat. size and magnified.

In the past season when, from the conditions of the weather during many weeks of the summer being very favourable to appearance of Hessian Fly, many observations of it might have been expected if the infestation was still present to any important extent in this country, I only received one report of its presence. This was sent me at the beginning of August, from Barton, near Marlborough, by Mr. D. D. Gibb, for many years a contributor to my Annual Reports, and who has especially helped me by notes of observation of this and other corn pests.

On August 4th I received a communication from Mr. Gibb, in which, after mentioning that he forwarded me some pieces of Wheat straw, which he considered showed the presence of insect pests to some considerable extent on the Wiltshire Downs, he further remarked:—

"My attention was called to part of a large field of Wheat, some fifty-eight acres, which as a whole was a satisfactory crop, say five quarters per acre. But in those parts where the soil was thinnest—near the chalk—the straw was very much broken and twisted over the ground. One of the very first straws examined yesterday, when the cutting was in operation, contained the "flax-seed" of Hessian Fly. On further examination to-day these do not seem to be so numerous over the field as at first expected. Wheat-bulb Fly has done most mischief, unless Hessian Fly attacked very early last autumn close to the root. In pulling, the empty pupa-cases fall out, after which it is difficult, without very careful examination, to distinguish between the two."

Together with Mr. Gibb's communication, he forwarded me a sample of the Hessian Fly infestation in the chrysalis or pupal state, in which it is commonly observed on straw in summer (see fig. 2, p. 86); but it will be noticed that Mr. Gibb also alludes to possibility of attack having occurred to the young autumn Wheat. This sometimes takes place to a destructive extent, but is much less observable than that to the summer straw, and I am not able to recall an instance of this

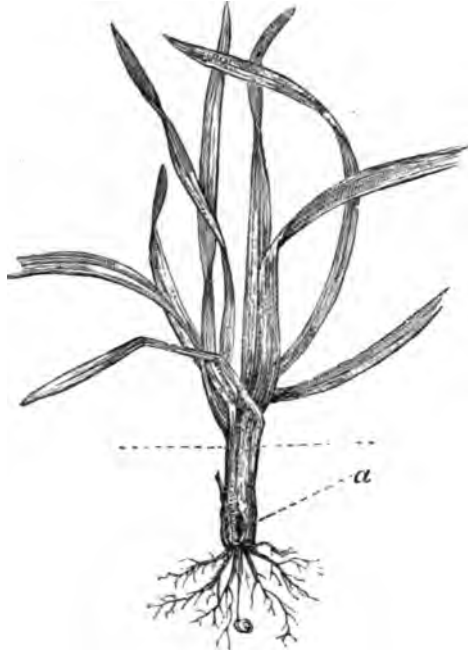
form of attack having been reported in this country. Therefore, though now after the experience of thirteen years there appears no reason to fear that we shall be troubled by Hessian Fly as one of the regular crop pests, I have alluded to the infestation again to bring information up to date regarding, firstly, method of winter infestation and its effect on the appearance of the attacked plants; secondly, the use according to the most modern views of the process beneath the larva, or maggot, known as the "breast-bone," or "anchor-process," more scientifically as the "sternal spatule," of which I gave a figure from life in my Annual Report for 1886, p. 15, and repeat it now at p. 87; and thirdly, the *enormously important point* that in the paper by Prof. Osborn (published under the direction of the Entomologist of the Department of Agriculture of the United States, and forming Bulletin No. 16, New Series, of the publications of that department) it is noted that burning the stubble is one of the standard measures of prevention which is most generally applicable in the United States of America, and also attention is drawn to *the desirability of burning chaff and screenings after threshing*. These matters are entered on in detail in the following pages.

The ordinary points of the attack are well known; but it may just be mentioned again that the *Cecidomyia destructor*, or Hessian Fly, is a very small two-winged gnat-like fly, hardly as much as one-tenth of an inch in length; the male one-third shorter than the female; the wings clothed with black hairs or scales; and the general appearance of the body very dark. When magnified, it will be found to be varied with pink, or red, or yellowish brown, and black, the black being more present in the male than the female.* The bright red colour which the abdomen of the newly-developed female appears to the unassisted eye is very noticeable to trained observers, and it is of considerable interest to watch the gradual alterations of colour.

The method of attack is for the fly to lay her reddish eggs in the long furrows of the upper surface of the leaves of the Wheat or Barley or Rye. On the hatching of the maggot, which it is stated may take place in about four days, it then, in its first and *locomotive* state, moves down the leaf, and along within the leaf-sheath, until it reaches a position near the base of the culm, but necessarily differing in position, and in its effect on the plant, according to whether it occurs to the young autumn Wheat, or when the plant is in its summer state with its jointed stem.

* For long and minutely detailed technical description of male and female *Cecidomyia destructor*, Say, see account by Mr. R. H. Meade (from living specimens), published in the 'Entomologist' for July, 1887; and also given at pp. 15 and 16 of my Annual Report for 1887 by permission of Mr. Meade, and of Mr. Newman, proprietor of the 'Entomologist.'—(E. A. O.)

The accompanying figure shows a young Wheat plant infested by Hessian Fly, the position of the pupa below the ground being shown



Plant of young Wheat showing position of Hessian Fly maggot at *a*.
(After Prof. Webster.)

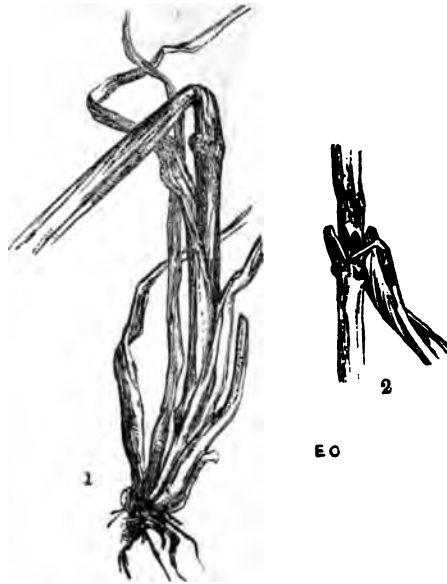
at *a*. In a circular by Prof. Webster, of Lafayette, Indiana, U.S.A., from which this figure is copied, giving his experiences of three years' special observation of Hessian Fly maggot attack on young Wheat, and from which I quote in my Annual Report for 1887, he mentions that he considered that the winter presence might be detected by peculiarities of the growth and colour of the infested plant. He pointed out regarding the condition of the plant figured, "The plant itself has not tillered; the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf, and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infested plant from one not injured."—(F. M. W.)

This is the state of things where the plant has been attacked before it tillers; but (as has been remarked) in case the plant has tillered, the Hessian Fly maggot may only attack one, or some of the tillered shoots, and the rest of the tillers may develop into healthy stalks, and give a crop.

The progress and effect of this larval infestation are thus described by Prof. Osborn, U.S.A.,* in his recent most valuable condensation of information up to date on Hessian Fly attack:—

“In autumn the eggs are laid upon the early appearing leaves, and the passage of the larvæ down the sheath carries them down to or below the surface of the ground, often very near to the root itself. Here their presence causes more or less swelling of the base of leaf and culm, scarcely enough to be counted a gall formation, but the immediate effect seems to be a stimulus at the point of attack.”

The above describes the effect of infestation on autumn or winter Wheat before the plant has developed; in the case of presence on the spring Wheat when the stalk has grown, it is very much more noticeable. In this state of growth the maggot makes its way similarly



Attacked Barley-stem: 1, bent down; 2, showing “flax-seeds.”

down the leaves, but there under the sheathing-leaf it takes a position commonly above the first or second knot, and ends its *locomotive* life. It remains fixed at one spot, feeding on the juices of the stem, which thus becomes weakened at the place of suction, until it bends, or “elbows” down, as shown in the figure, drawn from life by myself.

By this—that is, by the “elbowing,” or bending down of the straw at an acute angle—the Hessian Fly infestation may be easily distinguished from all of our other corn stem infestations, and also the

* See ‘Hessian Fly in the United States,’ by Prof. Herbert Osborn, p. 27; Bulletin No. 16, New Series, U.S. Dept. of Agriculture, Washington, 1898.

losses from the mere injury to the yield are increased. This diminution of produce may be more or less according to circumstances, but damage to the heads, from their fallen position, and inconveniences in harvesting from the confused state of the crop, add much to troubles.

Fig. 2, p. 86, shows the next stage of condition. After remaining as above from a period variously estimated as from about twenty to twenty-eight days, the white legless maggot contracts, the outer skin hardens, and it changes to a somewhat flat brown chrysalis-case, so exceedingly like a rather small and narrow flax-seed in size and also in shape and colour, that the name of "flax-seed" is commonly given to the *puparium*, or chrysalis-case (see figure). Within this case the maggot goes through its changes to the perfect fly, or gnat-midge. This may take place so that the whole time of development from egg to fly state is only forty-eight days; but the time occupied may vary much, some of the flies may come out the same autumn, and others, threshed out, or kept in the straw, or preserved artificially for investigation, may very likely not hatch out until May or later in the following year. My own first specimen (which I conjecture to be the first of which the appearance has been definitely recorded in Britain) made its appearance on September 8th, 1886, from infested Barley straw collected not earlier than the preceding 27th of July, and from its bright red colour, by which attention was drawn to it, must have been very recently developed.



FIG. 2
Flax-seeds, or puparia,
in different stages of
development, natural
size and magnified.

Returning now to the condition of the maggot, or larva, after the external change of its appearance to the "flax-seed" state, there are some points regarding its structure brought forward by Prof. Osborn (see p. 16 of his work, previously quoted), which are of considerable interest. Beneath the maggot, whilst still in its general white state within its newly formed brown coating, and very near the head, is a chitinous or horny appendage, known as the "breast-bone," or anchor. This process consists of a short stem fixed at one end to the larva, and free at the other extremity, which points forward. The fixed end is placed between the first and second segments. The shape of the free end is conveyed by the accompanying figure, which was taken by myself from life, and gives a very fair idea of the stem of the process, which is about the same width for half its length, and then gradually swells out, and is terminated by two conical prolongations, forming together a strong fork.



Breast-bone of
C. destructor,
greatly magnified.

Regarding the precise use of this process, called now the "sternal spatule," or "breast-bone," there has been much speculation, and it is now considered by Prof. Osborn that the opinion which is best supported is that the "spatule" is used by the larva to reverse its position in the *puparium*, so that, whereas the larva rests at first with its head downward and toward the roots of the plant, it rests after turning with its head upward and toward the upper part of the plant.—(H. O.) On this matter I do not feel qualified to offer an opinion; but, reasoning by analogy, my views have leaned towards it possibly having uses as a scraper, or digger, as in microscopic investigation of the larvæ of one of our Willow *Cecidomyia* it certainly appeared to me that I found minute amount of woody matter attached to the free head of the "breast-bone," giving the idea of this differently shaped free end being of service in making its way in the harder material. This, however, is merely a conjecture of my own.

PREVENTION AND REMEDIES.—As the attack (as a practical evil) seems to have almost entirely passed away from among us, there appears no occasion to enter on preventive measures, which are as a general thing quite uncalled for, but of which the details are thoroughly well known and accessible if needed.

Amongst these, however, there is one method of treatment which in this country we apply for the most part so customarily in the regular process of our agricultural arrangements, that it may be well to allude to it, and this is *the date of sowing of our autumn Wheat*. In U.S.A. practice, where "fall" or autumn Wheat sowing runs earlier than with us, it has been especially recommended that sowing should not take place until after the 20th of September in the northern States; the date of course varies in different countries according to differences in temperature, but commonly with us Wheat is not sown until danger of infestation from Hessian Fly is past.

In ordinary natural circumstances the life of the flies is very short, and considered not to extend beyond a few days, and if in this short time there are no plants at hand for egg deposit on which the maggots can feed, this is an enormously important measure of prevention. It not only is the saving of the crop, which might wholly or partially have perished in young state, but it lessens the attacks of the year by preventing occurrence of the winter generation.

One other highly important point which should always be borne in mind by those who find their crops of Wheat or Barley suffering under attack of Hessian Fly in summer is that after threshing *all the infested chaff* or light screenings should be burnt or soaked, or in some way thoroughly destroyed.

In the valuable Bulletin on Hessian Fly by Prof. Herbert Osborn,

published by the United States Department of Agriculture (referred to *ante*), attention is strongly drawn at p. 42 to the great importance of destroying the *puparia*, or chrysalis-cases, of an infested crop by burning the stubbles, or by destroying the chaff in which these "flax-seeds" are to be found after threshing.

From circumstances of climate, custom, and also from straw being in this country cut so low that much of the infestation is carried off the field with it, the plan of burning the stubbles is not so applicable with us as in the United States. Something, however, might be done in case of straw being noticed to be badly infested towards preventing flax-seeds left in the short stubble developing to fly, by "skimming," and then dragging the rubbish together and burning it.

Burning the chaff and infested light screenings is a very important point. The light screenings, which are chiefly of dust, small weed seeds, and the like, being thrown down together by the threshing-machines, there is little difficulty or expense in gathering them up and destroying them. If it is troublesome to burn this infested material, it may be thoroughly mixed in wet manure. This would not certainly destroy the weed seeds, but it would make an end of the *puparia*.

Objections have been raised (theoretically) to this treatment, that thus we destroy the parasites which *might* be in the Hessian Fly puparia, or chrysalis-cases, and which *might* develop into little parasite flies, and *might* fly to the Wheat and Barley fields, and there destroy the Hessian Fly in its embryo state. But this benefit is problematical, and if we burn the light screenings and the contents, we kill the Hessian Fly in its young state thoroughly and undoubtedly, whilst our hand is on it, without waiting for the involved considerations of letting it go to do certain harm, and the parasites to do an uncertain amount of good.

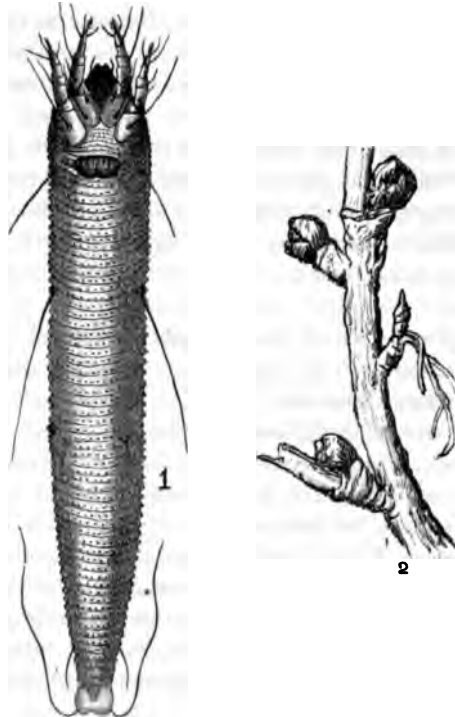
At one time the matter of preservation of infested screenings was so strongly *endeavoured* to be upheld here in some quarters (though never, so far as I am aware, by those with good practical knowledge of the bearing of the subject), that the late Prof. Riley, Entomologist of the U.S.A. Dept. of Agriculture, wrote me especially on the subject, saying that he had no doubt that, whatever might be the case in America, *in this country the right course was to destroy the puparia*.

Now, in the work of Prof. Osborn, which is an admirable digest of information up to date, we have the recommendation (as one of the standard remedies most generally applicable) to destroy the *puparia* when and where we can by burning the stubble, or burning chaff and infested screenings; and personally I would most earnestly advise all concerned in this country not to listen to any unproved theories on the subject, but just to destroy the pest when it is in their power.

During the past season little communication regarding presence of our common corn crop attacks was sent, excepting some very local observations on Corn Sawfly and Wheat-bulb Maggot. Injury from Corn Sawfly is caused by the maggot feeding within the stem, and finally gnawing it nearly through in a ring from the inside about ground-level, the straw consequently falling. The maggot changes to fly in the remaining part of the stem, and therefore "skimming" and collecting the stubble and burning it before the fly comes out in the following early summer is a sure remedy. Wheat-bulb Maggot does not call for further notice; and "Wireworm" is noticed under "Hops," as some good remedial treatment was suggested regarding its attack to this crop. A note on carnivorous Wireworms is also given.

CURRENT.

Current Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0.23 mm. (By permission, after Dr. A. Nalepa.) Black Currant twig with three buds affected by Mite Galls, and one bud unaffected.

Careful experiment has still been continued on all points which appeared likely to throw light on means of prevention of the Black Currant Mite Gall disease, which for so long has been a yearly cause of great loss to growers on a large scale. So far as I am aware, however, none of the chemical applications which have been tried have given satisfactory results by destroying the infestation without injury to the plant growth; but as these observations will, I believe, be fully reported on in detail, I am only entering here on some parallel experiments carried on in connection with observations at the Woburn Experimental Fruit Farm, Ridgmont, Beds, which I have the pleasure of taking some small part in, and am permitted to mention here.

The object of the investigation was to ascertain whether the attack was propagated in part by Currant Gall Mites, that is, *Phytoptus ribis*, harbouring in the earth at the roots or round the bases of the stems of the Currant bushes.

We know that the mite is to be found in the Black Currant buds during a great part of the year. From about the middle of July, when the young buds of the season are forming, the swollen galled growths may be found to be commencing, and even at that early date the mite (or *Acarus*) may be found in all stages from egg onwards within; as time goes on the growth of the galled buds progresses, till they are only too conspicuous as green mis-shapen balls of abortive leaves, or, when partially opened, as perishing rosette-like masses, crowded within (as long as the vegetable matter is sufficiently soft to give support to the parasites) with legions of the minute cylindrical four-legged mites, of which an enormously magnified figure is given at p. 40. About the beginning of June, if any of the old galls are still sufficiently alive to furnish food, the *Phytopti* may be found in them, and they are also to be found (both as old and young mites) between the base of the leafstalk and the buds at the ends of the young shoots.*

So far as appears, we are perfectly acquainted with the history of the mite on the plants in their above-ground life; but very careful investigation was needed to discover whether spread of infestation took place from mites sheltered in the earth at the base of the stems.

For this purpose it was arranged that Black Currant plants taken from the Woburn grounds, where the infestation was present, should be quite cut down to the ground and removed, some with the earth adhering, but no other way treated excepting in being quite cut down; and some others similarly cut down, and also washed in a mixture of

* For precise history of *P. ribis* through the year, see "Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5-7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

methyated spirit and water. It appeared that, in the case of these plants being removed to gardens *certainly* known neither to have or to have had infestation present for many years, if the mites and the mite-galls appeared on the growth from the removed roots, the *Phytopti* must have travelled with the plants, and thus we should gain knowledge of a locality where we might attack the pests.

My own garden at St. Albans was especially well adapted for experiment, as to my knowledge from personal observation there had been no presence of mite-galls on the bushes for the whole period which I had known it, namely, since September in the year 1887, and I was very glad to take part in the parallel series of observations.

Accordingly, on November 1st, 1898, a small consignment of six plants of Black Naples, and six of Baldwin's Black Currants, was forwarded to me from the Woburn Experimental Fruit Farm. This dozen of plants had simply been cut down, but nothing else had been done to them; they arrived in due course, and were immediately planted in my garden in a favourable position for growth.

Another consignment, also of six plants of Black Naples and six of Baldwin's Black Currants, was sent me two days afterwards. These had likewise been cut down, but had undergone the further treatment of being steeped (both roots and short remaining portions of stems) for two hours in equal volumes of methyated spirit and water. These also were planted promptly; with the approval of Mr. L. Castle, Manager of the Experimental Fruit Farm, of the localities chosen, and especially of the two consignments of plants being completely isolated.

Of the twelve plants which had merely been transplanted after being cut down one plant died; of the twelve which had been subjected to the severe treatment of being steeped for two hours in spirit and water, in addition to being cut down, four died. The remainder made growth naturally, and on examination taken early in November, 1899, a few days over a year from the date of planting, those which had merely been removed averaged in number of shoots about eight each, the length of the shoots being about eighteen inches. The plants which had been washed averaged about five in number in shoots, the length of the shoots being about fifteen inches. From the above points it was obvious that the washing was by no means good for the general health of the plants, and it may be further added that, although the simply moved plants appeared excellently healthy, the others were by no means in equally good condition. This simply refers to conditions of health, not to any considerations of mite presence or mite-gall growth, from which all of the plants on the most careful examination, as well as minute investigation of interior of the bud, proved through the whole course of observations to be entirely free.

On October 18th, Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, under whose microscopic superintendence the *Phytoptus* investigations have been carried on, wrote me regarding results of his examination of the condition of my experimental bushes as follows :—

“I find no trace of *Phytoptus* in any of the buds from the four lots of bushes in your garden at Torrington. Moreover, the buds appear perfectly healthy, and considering the treatment of the plants they have made good growths.”—(R. N.)

On a subsequent (also microscopic) examination of buds taken from the above-mentioned plots of Black Currants on Nov. 12th, Mr. Newstead reported that, with regard to the “Baldwins” and Black Naples which had been merely closely cut down and removed from the Ridgmont grounds to my garden at St. Albans, he found both kinds perfectly free from *Phytoptus* infestation in the buds, and with no external signs of the diseased growth, and also that the plants appeared to be in perfect health.

With regard to the others which had been cut down, but likewise steeped for two hours in equal parts of methylated spirit and water, Mr. Newstead found no signs of mites about them, and the buds were perfectly healthy. The plants (as detailed above) were less vigorous than those which had merely been transplanted, but still those which had survived it had made fair growth.

In the same report, Mr. Newstead mentioned that he found the isolated plots of Black Currants which had, like those in my own garden, been removed from the experimental ground at Ridgmont, where the *Phytoptus* infestation was present, to the garden of Mr. Spencer Pickering, F.R.S. (Director of the Woburn Experimental Fruit Farm), at Harpenden, where *no infestation was present*, gave equally satisfactory results. Mr. Newstead reported :—

“I do not find a trace of *Phytopti* in them. The buds on the shoots forwarded to me were perfectly healthy, and judging from these I should say the plants were even more vigorous than those in your garden at St. Albans.”—(R. N.)

Thus we found that in all the instances under observation there was *no conveyance of infestation in the earth at the roots of the Currants*. Although they had been taken up from infested ground, yet where they were planted in gardens known to be clean from the pest, the plants were found on the most stringent examination to be quite free of all *Phytoptus* presence on their shoots and buds subsequently growing from the transplanted roots.

To complete the experiment, observations were taken as to what might occur to Black Currant removed to the Ridgmont Experimental Grounds, but *not to isolated gardens known to be free from Phytoptus*

presence. In this case the clean plants, which were transplanted to the fruit farm at Ridgmont, where there is infestation, *did not escape the pest.* A number of buds were found by Mr. Newstead to be *badly* infested.

Some Black Currant plants imported from the Continent (presumed to be mite-proof), which have been growing for a year in close contact with diseased bushes at Newton Farm, Newton, Glasgow, N.B., under the observation of Mr. John Speer, up to date of report on Dec. 5th showed no external signs of disease. But we need another season's observation to test condition definitely.

Amongst various points suggested by the above observations, one very important practical point is the confirmation it gives to the utter uselessness of expecting to grow large areas of Black Currants without infestation of the Gall Mite. This point has repeatedly been noticed, and by some of our soundest observers, to be the case; but it adds further force to the arguments to find that plants placed in non-infested localities preserved the shoots from the ground perfectly clean, yet if placed, as above mentioned, in or at a given distance* from an infested area became infested by the mite-tenanted galls.

To a certain degree the experiments may save trouble, as, for instance, in attempts made to counteract the infestation by cutting down bushes to get a new clean growth, and in dressing the ground round the base of the Currant stems with chemical applications in winter to kill mites. The plan of cutting down the stems has been one of those tried for some time back, though never, I believe, with success for more than possibly a year or two, and (so far as I am aware) the cut-down plants have not been moved from the infested plots, which would quite account for the failure of the experiment.

In what way the mites are conveyed, or convey themselves, as in the above instance, over a more or less extensive area we do not know. Where bushes stand close together, and also in the fruit-gathering season, workers are going to and fro amongst them, it is obvious that mites may easily spread, or be spread, from the bushes, especially at the time when the mites are migrating (see p. 41) from old galled buds to shelter at the base of those which in the middle of summer are just beginning to form.

But where transit has to be made above or on clear ground, the method of operation is still unknown. The plumage of birds might of course afford one method of carriage, and also where the galled buds have grown to the stage at which in drying up they open like a loosely made rosette the dried abortive leaves might be blown by the wind with the mites adhering. It can hardly be supposed that the mites

* The actual distance at which the plants were separated from the infested area was about fifty yards.

would travel along the ground, as their peculiar long, narrow, cylindrical shape, with their two pairs of legs appended at one extremity, appears entirely to unfit them for this kind of progression.

We still, so far as *preventive* measures are concerned, remain where we were, and breaking off the galled buds and destroying them appears to be about the only *practically* available method; but the observations detailed above show still more plainly than before that where Black Currants are grown in large areas (or even in large plots) near to each other, it must be with an appreciable addition of cost at so much per measure for clearing galls, if the plants are to be kept even moderately free.

Another observation which we made to some small extent was with regard to whether Currant plants which were known never, or never during the years under which they have been under observation, to be infested in their own place of growth would remain "mite-free" when transplanted to an infested ground. With this view some seedling plants from the plot in my own garden, which, as mentioned at p. 42, was noticeably free from *Phytoptus* presence, were removed to the Ridgmont grounds, and there *all of them became infested*. Also some plants moved from the garden of Mr. Spencer Pickering, at Harpenden, which is clean from infestation, became infested when moved to the Ridgmont grounds.

The life-history of this attack and the various attempts to cope with it, and everything that we are acquainted with bearing on the infestation, has been entered on in my Annual Reports from that for 1885, inclusive, up to date, with the exception of those for 1886, 1890, 1895, and 1896, and especially entered on at great length, with notes of the first records of observation of it in England in my Annual Report for 1897, pp. 141-158; therefore I only now give the above additional observations, and this more particularly as I believe that at no distant date a detailed account will be prepared of the careful experiments which have been carried on at the Experimental Fruit Farm at Ridgmont.

"Spinach Moth."* *Cidaria dotata*, Linn.



CIDARIA DOTATA (from Newman's 'British Moths,' p. 193).

On July 4th I was favoured by Mr. Rouse Orlebar, of Hinwick Lodge, Wellingborough, with an excellent specimen of the moth, figured above, sometimes known as the "Spinach Moth" (scientifically *Cidaria dotata*, Linn.), as a sample of an infestation which had attacked his Red Currant trees to a considerable extent this year.

The moth is about an inch and three-eighths in the spread of the fore wings, which are of an ochreous yellow ground colour, with transverse lines, all sharply angled, but of various widths and various depths of colour; the two lowest near the base of the wing point, and slender; the next line distinct; the two next slender and indistinct; the next (that is, the sixth transverse line from the base of the wing) very distinct, with the inner margin shaded off into the colour of the wing, and the outer margin sharply defined and accompanied by a paler line. At the tip of the wing at the front angle is an oblique very short streak dividing the fore (costal) margin from the hinder margin, the latter being the palest. The fringe is pale, and (typically) is described as having eight brown spots; my specimen had seven spots on the fringe of one fore wing, and six on that of the other. The hind wings, which are very pale and slightly yellower towards the hinder margin, have a pale fringe with four or five dark spots. The head and body are pale yellow.

The caterpillars are yellowish and, as described by Dr. Ernst Hofmann,† "are rather more than an inch long, bluish green, and smallest at the fore part. Dorsal line darker green, with yellowish segmental divisions. On each side of the dorsal line, whitish, the line containing the spiracles yellow, but often absent. Spiracles ringed with clear brown, not projecting. Beneath grey green, with a yellowish central line. Head as wide as the first segment, entirely yellow; neck shield not distinguishable; tail flap small yellowish. Warts very

* The name of Spinach Moth appears somewhat misleading, but as it is an accepted appellation I have given it. Several of this genus of moths are known as "Carpet" Moths, with a word descriptive of some characteristic prefixed.

† See 'Raupen der Gross Schmetterlinge Europas,' von Prof. Dr. Ernst Hofmann, vol. (Text) p. 234. Stuttgart, 1893.

small, of the colour of the body. Claw feet clear yellow brown; sucker feet and caudal feet yellow, the latter with rather strong horizontal prolongations."

The short account of appearance and method of feeding of the caterpillar, quoted from the description of Mr. Wormald by Edw. Newman,* is as follows:—"It rests on the posterior claspers, with the head and the legs contracted; it is smooth, without lumps or warts, long, slender, and attenuated towards the head; the colour is pale yellowish green, with the dorsal line darker, and the subdorsal lines pale yellow and indistinct. It feeds at night on the Black Currant (*Ribes nigrum*). Its habit is very sluggish, remaining for several days on one twig, and feeding on all the leaves within its reach before changing its position. The eggs were laid on the 8rd of August, and hatched in the second week of April, and the caterpillar was full-fed at the beginning of June, when it spun a slight cocoon on the surface of the ground."

It is also mentioned (at p. 193, referred to in note), "Mr. Double-day informs me that at Epping this caterpillar always feeds on the Red Currant."

On applying to Mr. Orlebar for any further notes of observation of the attack which he might be good enough to favour me with, he kindly added the following somewhat important remarks:—

"I did not notice the attack as becoming serious until about June 1st, and the caterpillar was fully fed about the 10th. I notice that Edw. Newman does not give his own account of the caterpillar, but quotes Mr. Wormald, who says that it feeds on the Black Currant; but it has not done so here, the Red Currant only being attacked. He also says it is a night feeder. This I did not notice, but I should think it probable, as its position by day was usually upon the stalk of the leaf, where it was resting with its body slightly arched. It hung by a thread when disturbed. . . . He" (Mr. Wormald), "however, states that 'it spun a slight cocoon on the surface of the ground,' which is contrary to what I observed here, where it invariably made a very slight though very strong web, not less than three feet from the ground, on the stem of the bush itself, and generally at the junction of the young wood and the old. This difference seems to me of some importance, as of course different methods of destroying the chrysalis would be necessary if the pest became at all general. The moth appeared on the wing about the end of June."—(R. O.)

The slight differences in description of the appearance of the caterpillar—as, for instance, the English observation of it as "smooth, without warts or lumps," and the German as "warts, very small, of the colour of the body"—do not seem to me very important, as higher

* See 'British Moths,' p. 193.

magnifying powers may have been used for the more detailed description; but the locality of the cocoon certainly is, and to the two, above given, Dr. Hofmann adds a third. He mentions that the larva feeds on *Asperula galioides* and *Galium verum* and other kinds of *Galium*,* and that transformation takes place in a slight web, between the leaves or blossoms of the food-plants. Conjecturally, if we had more observations we should find that locality of pupation varied with special circumstances, or with the nature of the food-plant.

PREVENTION AND REMEDY.—The eggs are stated to be laid in August, and to hatch in the following April; but unless by the application of kerosine emulsion, which will sometimes destroy vitality in eggs, it scarcely appears possible to get rid of the pest in the egg state.

The only remedial measures which seem practicable are clearing the web-cocoons containing the caterpillar or chrysalis. This might be done by hand-picking from the Currant stems, or by clearing any leaves or other parts of the attacked plants (Currant or otherwise), which may have been spun up. If the cocoons are found on the surface of the ground these might usually be very easily got rid of by just skimming them off with a spade run flat half an inch or so beneath them and destroying them.

In the case of the American species, *Cidaria diversilineata*, Hübn., of which the caterpillars feed on Vine leaves, the infestation is double-brooded. The second brood passes the winter in caterpillar state, coming out in spring to feed, and very soon after going through the changes to the moth condition.† The remedies advised for this attack where the “larvæ are sufficiently numerous to prove troublesome” are syringing with Paris-green in water, or with hellebore in water; but these remedies would need great care in application if admissible at all on crops for domestic use so far advanced as Currant fruit during the month of June.

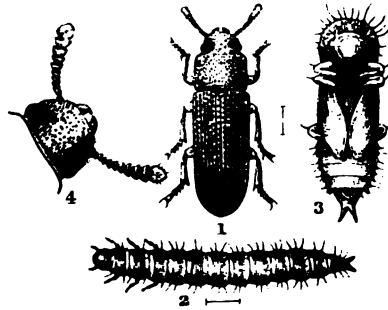
* The different species of *Galium* are for the most part known with us by the name of Bedstraw; *G. verum* as the “Yellow Bedstraw.” A popular name of several species of *Asperula* is Woodruff, also with some prefix; but *A. galioides* is not given as an English plant in ‘Sowerby’s British Botany.’

† See ‘Insects Injurious to Fruits,’ by Dr. W. Saunders, Director of the Government Experimental Farms in Canada, p. 270.

FLOUR AND GRAIN BEETLES.

Rust-red Flour Beetle. *Tribolium ferrugineum*, Fab.

Confused Flour Beetle. *Tribolium confusum*, Duv.



TRIBOLIUM FERRUGINEUM.—1, beetle; 2, larva; 3, pupa—magnified, and with lines showing natural length; 4, head with antennæ, much magnified.

The Rust-red Flour Beetle, figured above, is sometimes described as being a cosmopolitan species, but it should more accurately be said to be present in all parts of the world which are warm enough to suit its habits. In this country it has been noticed at a good many localities, extending in England as far northwards as Northumberland, and in Scotland in the Forth district, and is recorded as occurring in flour; also as being often found in bakers' shops, and occasionally taken under the bark of old trees, and it is said to be common. It was not, however, until the past season that it was brought under my notice, not as a home pest, but as an infestation to which cargoes of flour transmitted to us from various parts of the world were seriously liable.

The insects appear to be by no means strictly limited in their diet (and consequently infestation may spread from quarters where it might not have been expected); but, without minute specification here, it attacks grain in the form of cereals, and other seeds, articles containing farinaceous matters, and very especially flour and meal.

The various cases of infestation which I had the opportunity of examining were in Wheat flour; and in one of these, transmitted direct from one of the most southerly ports of the United States, I found the infestation so numerous present that I had excellent opportunity of studying it in its various stages, and also of noticing the discoloured and injured state of the flour, which is a characteristic of its presence where this occurs to anything like the extent commonly understood by the word "*infestation*."

The following short notes of some of the chief characteristic points of the larva and pupa are taken from 'The Coleoptera of the British Islands,' by the Rev. Canon Fowler, vol. v. p. 20:—

"The larva is linear and parallel, slightly narrowed towards apex, of a rufo-ferruginous colour above and paler below, the segments are furnished on each side with setæ, and the anal segment is very small and terminates in two short pointed appendages.

"The pupa is much longer than broad, and is set with rather short setæ, the plates at the sides are strongly bifid, and the cerci are comparatively long, and sharply pointed at apex."

In the sample of infested U.S.A. Wheat-flour which was sent me for examination, I found about fifty of the *T. ferrugineum* beetles and a good supply of larvæ. These larvæ, or maggots, were of various sizes, from about three-sixteenths to two-eighths of an inch in length, or, in one instance, rather more when the maggot was quite fully extended in walking. The width approximately one-eighth of the length. The surface shiny, with some hairs; the shape cylindrical, parallel-sided for most of the length, but lessening towards the tail extremity, which was terminated by two pointed processes (see figure, p. 49). The colour ochreous; when seen magnified, the segments pale at the edges, above broadly banded transversely with ochreous, the cross-bands being darkest on the segments nearest the tip of the tail, the under side of the larva pale or white. The fore part of the head ochreous, mandibles darker, and brown at their pointed tips; antennæ in length about half the transverse width of the head. The six claw-feet white or very pale, slender, and of sufficient length to allow the larva to walk easily, and at a fair rate of progression.

The figure of the pupa (p. 49) and the description above are perhaps enough for practical purposes; but I observed that the striæ on the *elytra* (wing-cases) folded beneath the body were very noticeable with a two-inch focus object-glass, as also the two pointed processes at the tip of the abdomen. The length was about one-sixth of an inch.

The beetles are of rusty-red or reddish yellow-brown in colour, elongate, parallel-sided, rather depressed; head and thorax thickly punctured, head comparatively large but narrower than thorax; the latter broader than long; the antennæ rusty-red, "with the three last joints forming a club,"* terminal joint paler; wings ample, and were

* The three last joints of the antennæ forming a club, and likewise the head not being expanded beyond the eyes at the side, are characteristics by which this species, that is, *T. ferrugineum*, Fab. (*T. castaneum*, Herbst; *Stene ferrugineum*, Kirby) may be especially distinguished from *T. confusum*, Duval. This species occurs in England, but is considered not to be as common with us as *ferrugineum*, which it closely resembles in colour, form, size, habits, and life-history; but in the United States of America this species (*T. confusum*) is stated from the time of its first recognition in the country as a distinct species to have been "reported as injurious in nearly every State and Territory in the Union."

easily observable by separating the abdomen of a dead specimen and slightly crushing it in water, so that the wings expanded and floated; wing-cases with punctured striæ; legs ferruginous. Length from slightly under up to one-sixth of an inch.

The infested Wheat-flour in the tubes sent me was noticeably not of a pure white, but of a greyish tint, and when the tubes were placed on a bed of perfectly good white flour, the discoloration of that in the tubes was very clearly appreciable. This discoloration is one very important proof of presence of infestation, as mentioned in the following extract from the heading to observations on "Flour Beetles," by Mr. F. H. Chittenden, p. 112 of publication referred to below* :—

"Their eggs are often deposited in the flour in the mills, and these and the larvæ they produce being minute and pale in colour readily escape notice; but after the flour has been barreled or placed in bags and left unopened for any length of time, the adult beetles make their appearance, and in due course the flour is ruined, for when the insects have time to propagate they soon convert the flour into a grey useless mass. A part of the annoyance to purchaser, dealer, and manufacturer is due to the fact that the insects are highly offensive, a few specimens being sufficient to impart a disagreeable and persistent odour to the infested substance."—(F. H. C.)

I had not sufficient material to give opportunity of thorough observation of the matter of unpleasantness of smell, but the grey colour was very observable, also the injured state of the flour.

The geographical distribution of this species is of considerable importance as to possibilities of its transmission in cargoes of grain or flour, and the following observations on this head are taken from some of the notices on 'Insect Life,' published by the Division of Entomology of the U.S. Department of Agriculture, Washington.

In "Nos. 7 and 8," vol. iii., 1891, at p. 333, is a note of damage caused by this infestation in company with other kinds being forwarded by the U.S. Consul, Maracaibo, Venezuela (South America), to the Entomologist of the U.S.A. Department of Agriculture. In this case the damage was to ripe Indian corn after it was shelled and stored, and in the official reply it was stated that the four kinds sent were "cosmopolitan beetles, and infest stored grain all the world over."

In No. 8, vol. vi., Feb. 1894, Prof. C. V. Riley, in his report on "The Insects occurring in the Foreign Exhibits of the World's Columbian Exposition," mentioned that "*Tribolium ferrugineum*, Fab., occurred in the cereal exhibits of most of the countries of tropical and subtropical America, Asia, and Africa. . . . Common also in Europe, and well distributed over this country" [*i.e.* United States of

* 'The Principal Household Insects of the United States,' Bulletin No. 4, New Series, U.S. Dept. of Agriculture, Washington, 1896.

America, E. A. O.], "where it is sometimes called 'Flour Weevil,' and is often injurious to grain, meal, flour, and a great variety of other products" (C. V. R.).

In No. 4, vol. vii., of the above-named work, in a paper by Mr. F. H. Chittenden, it is mentioned at p. 329 that the writer had "seen specimens of the *Tribolium ferrugineum* from North Carolina, South Carolina, Georgia, Florida, Louisiana, Texas, Nebraska, Oklahoma, and California" (F. H. C.). Many other localities are given, but the above observations are quite enough to show that whether in cargoes of grain or flour, there is every possibility of this pest, *T. ferrugineum*, being shipped from almost any warm locality.

Tribolium confusum, Duv.—In the above observations I have tried to limit them to *T. ferrugineum*, but for business purposes some notice should be taken of *Tribolium confusum*, Duv., as this species is recorded as "being almost an exact counterpart of the Rust-red Flour Beetle (*T. ferrugineum*)," to closely resemble it "in colour, form, and size," and also in habits and life-history. This species differs from the "Rust-red" Flour Beetle in the antennæ, or horns, being less completely club-shaped—that is, they are gradually thickened to the extremity; in *T. ferrugineum* the last three joints forming a kind of club, in *confusum* the last five or six joints are wider than the preceding. Also this species has a broader head, and the sides of the head are expanded at the sides beyond the eyes.

Of this species it is said*:—" *Tribolium confusum*, Duv., derives its name from the fact that the species has been generally confused with *ferrugineum*. Prior to the appearance of Duval's description, published in 1868, both species were known under the latter name, and until within the year" [1895—E. A. O.] "the same has been the case in America. As a consequence, our literature, mostly treating of *ferrugineum*, may refer to either species." Without again going over details of geographical distribution, it may be mentioned that it occurs in England, France, Germany, and Italy, and is very generally distributed in the world, notably America; it is stated in 1896 that this species "has been reported as injurious in nearly every State and Territory in the Union."

Of this kind, it is stated:—"The tiny clear white eggs are attached to some convenient surface in the cracks or on the sides of the bag, barrel, or other receptacle in which the infested substance is contained. These hatch into minute larvæ, which feed for a period depending on the temperature, and then transform to naked white pupæ, which in due time change to beetles, which copulate soon after transformation, and another generation enters upon its life round. In this manner

* See 'Insect Life,' vol. vii., No. 4, p. 329, U.S. Department of Agriculture, Washington, U.S.A.

several broods are generated in the course of a year. From observations conducted by the writer" [Mr. F. H. Chittenden—E. A. O.], "it has been learned that this insect is capable in an exceptionally high temperature of undergoing its entire round of existence from egg to imago in thirty-six days. The minimum period of incubation was not ascertained, but it may be assumed as about six days. This, with six days for the pupal period, gives twenty-four days as the shortest developmental period of the larva. In cooler weather these periods last two or three times as long. In well-heated buildings in a latitude like that of Washington we thus have the possibility of at least four generations in a year." *

Looking at the circumstance that it is very recently that the two above-named species of beetle have been considered to be other than all of one kind, and that still they are recorded as closely resembling each other in colour, size, form, habits, and life-history, their preventive treatment may be laid down safely to be similar.

PREVENTION AND REMEDY.—A very important point in household or store treatment is scrupulously cleaning all barrels, tubs, lockers, bins, or other wooden depositories in which flour or grain that has been found to be infested by Flour Beetles may have been kept. A thorough "scrubbing" applied with *scalding hot water* by a good hard scrubbing-brush of the make with a few rows of longer bristles at one end, so that all chinks and crannies could be well cleared out, would probably be very effective. If soft-soap and a little mineral oil of any kind could be used in solution in the scalding water without danger of tainting the flour which might subsequently be placed in the cask or other wooden receptacle,—this of course would be a great additional safety.

The transmission of attack in connection with infested bags or packages is a most fertile source of mischief. Independently of bags containing flour, those that are returned empty convey the infestation, whether of the special kinds of Flour Beetles under consideration, or the "Granary Weevils," or the "Mediterranean Mill Moth" in legions; and it is not only in traffic to and fro, but where these infested bags are used *without proper purification* as ship packing material (technically, I believe, known as "dunnage"), that enormous mischief is done.

I have no record of this precise form of trouble having arisen with regard to the *Tribolium* beetles; but with regard to the *Calandra*, or Granary Weevils, observation has been put in my hands of the weevils being so swarming in the dunnage as to fall down the men's backs in the packing operations. This might be completely obviated, whether with the *Tribolium* or other infestation, by placing

* See 'Household Insects,' referred to, *ante*, at p. 51.

the bags in a raised temperature such as would kill the insects. Baking the bags would do all that is needed on the scale of moderate amount of material; but on a large scale, or where dry heat may be thought likely to hurt the material, the application of steam, as used to destroy "Flour Moth," may be used for disinfection, as recommended by the U.S.A. Department of Agriculture. Obviously the *method* of application varies with circumstances; in large scale workings a steam-tight chamber, in which bags, machinery, or anything requiring disinfecting might be placed, would be a means of doing excellent work.

In the details given me of operations in Ontario (Canada), under an Order of Council of the Local Government on appearance of the "Mediterranean Flour Moth" (*Ephestia kuhniella*) in that country in 1889, it was mentioned in a report from the "Canadian Steam Mills," especially suffering under the outbreak:—"In compliance with this order, we at once constructed a tight steam box, 6 ft. wide, 6 ft. high, and 12 ft. long, and attached a steam-pipe to it from the boiler." In this box every machine, and even the millstones and iron rollers, were submitted to purification by steam, and the measures taken "resulted in a complete eradication of the pest" from the premises.*

It is not for me to suppose that I can judge what arrangements are desirable at shipping ports, but it certainly *seems* that, where steam power is at hand, such a chamber which could be hired by anyone needing its services, would be an excellent adjunct; and very certainly a stricter supervision by owners' representatives, and a little more knowledge of the habits and appearance of the flour and grain pests would be a means of saving enormous losses.†

Preventive measures are especially desirable in case of flour infestation as *remedial* attempts are costly in any case, and may be injurious to the material. A rise of temperature, for instance, of from 120° to 150° F. will (it is stated) kill most insects, but a greater heat will injure the flour, and even this may be prejudicial.

Sieving removes the beetles and larger maggots (at a cost of so much per stone), but the eggs and small young maggots will probably pass through the meshes in numbers together with the flour.

* See Bulletin 1 and Appendix to Bulletin 1 on the 'Flour Moth,' issued by the Ontario Dept. of Agriculture, prepared by P. H. Bryce, Sec., quoted in my Thirteenth and Fifteenth Annual Reports, under the heading of "Flour Moth."

† There is a pamphlet of twenty-four pages entitled 'Some Insects Injurious to Stored Grain,' by F. H. Chittenden, Assistant Entomologist to the Department of Agriculture, Washington, U.S.A. (published by the Department), which cannot be too highly recommended to the notice of all connected with trade in flour or grain, whether on land or sea. It contains short, plain, practical information on about twenty kinds of flour and grain infestations, with numerous good figures, and likewise working notes of practicable common-sense remedial and preventive measures.

Fumigation by bisulphide of carbon is efficacious, but is dangerous both with regard to its great inflammability, and also *may* be prejudicial to the operators; but there are some broadscale methods of treatment which would save a deal of loss if they *were* more attended to, and which apply equally to the Rust-red Flour Beetles, and other kinds also infesting flour.

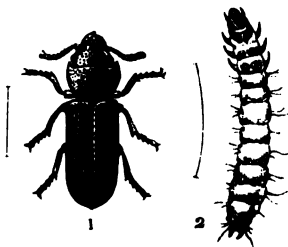
One of these is the "inspection, quarantining, and disinfection of infested or suspected grain, bags, and machinery before storage" (see 'Insects Injurious to Stored Grain,' referred to in note, p. 54). From enquiries sent to myself for some years past regarding cargoes of flour or grain received at various of our British or Irish ports from various parts of the world, I should say that attention to the first of the above items ("inspection") as soon as possible on arrival, and by some one interested in the matter, and *able to distinguish one kind of insect presence from another*, would often save a deal of subsequent trouble, also risk of loss from continuance of damage in the material, and likewise of spread of the infestation. In the case of the *Tribolium ferrugineum* beetles under consideration, they have ample wings, and could distribute themselves to anything liable to their infestation near at hand. "Quarantining" would be a preservative from this especial form of trouble; but with regard to the consignees or owners of the material, a *skilled* inspection of conditions of stores, sheds, or goods on the docks adjacent to where the barrels, bags, or other packages were to be placed would be highly desirable.

In a communication sent me a few years back regarding not much under a hundred barrels of flour, which consequently on beetle presence had to be emptied, sieved, and repacked, we found on investigation at the docks that a quantity of material next to which the flour was stored was swarming with the same insects. As the amount of beetles in my correspondent's eighty-five barrels was only sufficient to make sieving necessary to avoid a breach of regulations, it was presumable that the infestation arose from the "swarms" sheltered close by. The conditions of samples of infested cargoes on which I am consulted show, in some instances (taken together with the observations furnished), *beyond all doubt*, that the flour, or grain, was shipped in an infested state, or was packed on shipboard with material so infested with the "pest" (whatever it might be) on the "dunnage," &c., that the cause of the mischief *demonstrably* was present in the commencement of the transmission of the cargo. In other instances, for want of examination *on arrival* (before the consignment had been exposed to possibility of home infestation), there was hardly any way of arriving at certainty when the mischief began, consequently on whose shoulders the pecuniary loss should rest; and in cases of this kind, where referred after lapse of weeks to skilled investigation, the trouble

of absolutely making sure how the matter stands is something enormous.

Here we come to the point at which the amount of technical knowledge procurable in an hour or two's study from such a trustworthy and plainly worded publication as that referred to in note, p. 54, and investigations based on the knowledge would save constant loss and trouble. In my papers I have reports on condition of cargoes from stevedores, weighers, and samplers, whose porters landed cargo, and others too numerous to specify, but it is to a very slight extent that we get from such sources reliable evidence as to the amount or nature of insect presence. But the representative of those interested could very easily see to all that is needed, and amongst other points distinguish by five minutes' study between the injurious infestations and one which, when occurring in infested flour cargoes, there appears constantly so much more reason to believe is at least to some degree beneficial, that I give some notes on it in the following paper.

"Cadelle"; Bread Beetle (German). *Tenebrioides (Trogosita) mauritanicus*, L.



TENEBRIOIDES MAURITANICUS.—1, beetle; 2, larva: magnified, with lines showing natural length.

The name of "Cadelle" appears to be now given to *T. mauritanicus*, both in beetle and larval state; but in the early days of its observation this name was more especially bestowed upon the larva. The infestation is to be found in this country in bakers' shops, granaries, &c., but it is considered to be an imported species, and whether or not it was originally introduced to us from Africa, it has long been abundant in that country, as well as in America, and in a great part of Europe.

Its scientific appellation, which was in former days *Trogosita mauritanica*, has more recently been exchanged, for technical entomological reasons, to that of *Tenebrioides mauritanicus*, and recent investigations of its habits, on which opinions formerly greatly differed (or on which the observations were only imperfect), have now proved that both in

larval and in beetle condition it is to some degree carnivorous; that is, it *feeds on insects*, as well as on grain and on some other vegetable products.

The special mischief caused by this infestation with which it is credited from the time of Curtis onwards, is the damage which is caused by the larvæ feeding on stored grain. It is also stated that the larvæ are peculiarly destructive from their habit of eating the *outside of the grains*, and passing from one grain to another, and thus injuring more than they consume.

In the Bulletin on 'Insects Injurious to Stored Grain' (1897), referred to previously, which, so far as I am aware, gives the most recent information on the subject, is (at pp. 18, 19) the following valuable observation, which I quote verbatim, as in it Mr. Chittenden, Assistant Entomologist to the Department of Agriculture of the United States of America, records from his own personal observation the fact of *T. mauritanicus* being both in larval and pupal state a grain feeder; and afterwards also mentions definitely that in both conditions they are likewise insectivorous. Mr. Chittenden remarks as follows:—

"The statements of some of the earlier writers that this species is granivorous have been discredited by later authors. It has been experimentally proven by the writer, however, that the insect lives both in the larval and adult conditions upon grain; and furthermore, that were the insect more prolific it would become a source of much damage to seed stock, from its habit of devouring the embryo, or germ, going from kernel to kernel, and destroying for germinating purposes many more seeds than it consumes. Both larvæ and beetles serve a good purpose by attacking and destroying whatever other grain insects they happen to encounter."—(F. H. C.)

The infestation is recorded as being found in cereals, nuts, and almonds, besides other material, including bread, as noted by Dr. Taschenberg,* whence the German name of "Bread Beetle." It is also noted as being sometimes found in dead trees; and the beetle is observed by Taschenberg to be found at large under bark, or in decayed wood, where more or less it must have lived on prey, "*wo sie mehr, oder weniger vom Raube leben durften.*"

But though the decidedly insectivorous propensities of this infestation have long been known, I have not been able to find any precise description of the method of their operations (nor have I seen it myself in the case of the beetle). In the past season, however, in the course of some observations which I was making on the Rust-red Flour Beetles (*Tribolium ferrugineum*), I had occasion to keep a number of the beetles and larvæ in a sample of the Wheat-flour in which they had been imported from New Orleans, and with these were two larvæ of

* 'Praktische Insektenkunde,' pt. ii. pp. 16-18.

Tenebrioides mauritanicus, commonly known as the "Cadelle." On examining the collection carefully, I found several of the Flour Beetle maggots showing signs of attack, and having apparently been killed by biting and suction of their bodies; and besides these more or less injured specimens, others of the Flour Beetle maggots were lying in pieces in the flour. In this instance there were no other kinds of insects present excepting those mentioned above, so that it appeared impossible that the attack could have been from any other cause than from the deliberate onslaughts (so to call them) of the Cadelle.

This larva, or maggot, is whitish, fleshy, nearly three-quarters of an inch in length, and about a twelfth of an inch in breadth, cylindrical, but somewhat largest in the segments near the tail extremity, and slightly hairy, the hairs long at the sides. The head narrower than the body, hard, dark brown or black, with short antennæ, and is also furnished with a pair of curved, sharp, horny jaws. The segment behind the head is marked above by a transverse brown band, often divided longitudinally by a narrow white line, and the two following segments are each marked above by two brown spots. The tail segment is dark brown, and is terminated by two brown horny conical spines, and by these brown spines forming a kind of fork, and by these and by the brown spots on the second and third segment from the head the maggot is easily recognizable. The three pairs of claw feet on the segments next the head are long enough to be of use in walking.

The pupæ are about half an inch in length, white, and with the forming limbs folded beneath; but I have had no specimens to describe from. A good figure is given at p. 18 of Mr. Chittenden's Bulletin, referred to, *ante*, p. 54.

The beetle is elongate-oblong, depressed, from about a quarter to rather more than a third of an inch in length, blackish, or sometimes pitchy red in colour. Head broad, but narrower than fore body; antennæ (horns) slightly pubescent, and with a not very distinctly marked club; mouth with two strong bifid jaws meeting in front. Thorax broadest in front, with the anterior angles produced, narrowed behind. Wing-cases broader than the thorax, and nearly three times as long, with delicately punctured striæ; wings moderately ample; legs rather short.

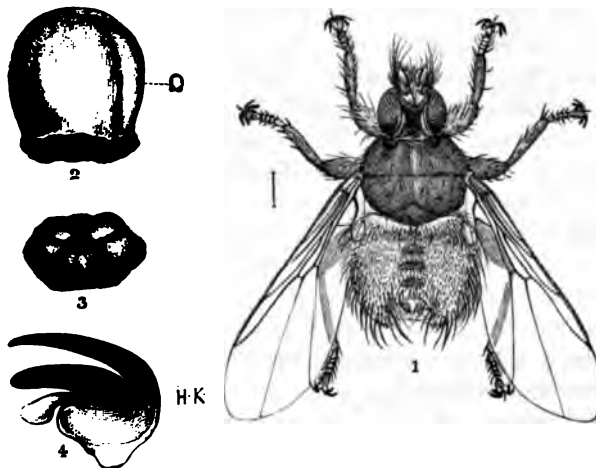
In regard to measures of prevention, these are to be less called for in the case of this infestation than with most of our other grain infestations, as there appears to be only one brood yearly. Also, when found in flour or meal (as we are not aware of either the beetle or its maggot feeding on these materials), it appears probable that if present they are doing us more good than harm in these localities.

As grain pests, the case is different; and the ordinary remedies,

such as disinfecting bags in which infested grain has been conveyed, clearing out all places of shelter in refuse, fumigation of bins, thick white-washing to stop up all chinks in walls, and the like remedies, would all be serviceable in getting rid of the infestation in stores, or bakeries, or similar places where it may occur with us.

GROUSE.

Grouse Fly. *Ornithomyia avicularia*, Linn.



ORNITHOMYIA AVICULARIA.—1, Grouse Fly, magnified, with line showing natural length; 2, puparium, magnified and natural size; 3, end view, magnified; 4, claw, magnified.

Ornithomyia avicularia, figured above, is a small two-winged fly from two and a half to three lines in length, tough or leathery, somewhat elliptical in shape, and flattened, of variable colour, but usually of some shade of brown, and is found on birds; with us it is chiefly noticed on Grouse (*Lagopus scoticus*), whence its usually adopted name of "Grouse Fly."

I am not aware of it ever being injurious or seriously troublesome to birds by its presence amongst their feathers, as the nearly allied "Horse Forest Fly" (*Hippobosca equina*) is amongst the hair of Horses and Cattle, or the "Deer Forest Fly" (*Lipoptera cervi*) amongst the hair of Deer; but observations are occasionally sent me regarding it being noticed in connection with Grouse; and the genus *Ornithomyia*,

of which up at least to 1888, the species *avicularia* appears to have been the only kind recorded as present in Britain, is of some interest from the peculiar structure of its claws. (See frontispiece.)

The Grouse Fly, as well as the Horse and the Deer Forest Flies, belongs to the division of the *Pupipara*, or pupa-bearing flies, characterised by their young not being produced in egg or larval state, but as *pupa*. That is, the larval growth takes place inside the abdomen of the female, and it is produced, or, popularly speaking, laid, as a pupa, or just at the time when the change from the larval (or maggot) state to that of the pupa is taking place. Previous to the exclusion, the abdomen of the mother fly is noticeably much enlarged; and contrariwise, when the pupa has been deposited, the shrunken state of the abdomen is strikingly observable.

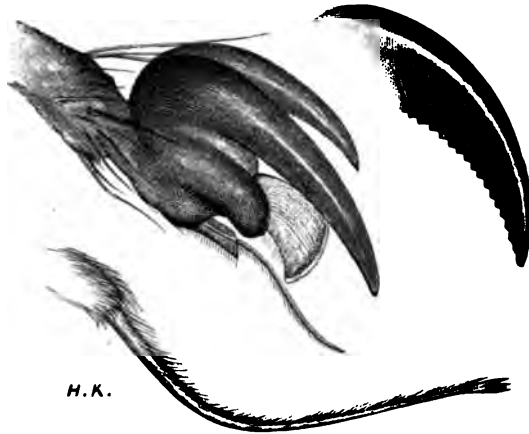
In the case of the *puparium* figured at p. 59, the mother Grouse Fly was sent me on August 13th from Swansfield House, Alnwick, by Mr. E. G. Wheler, with the observation, "I am sending you a Grouse Fly, which I hope may reach you alive. It is evidently a female with pupa." On receipt of the specimen, I forwarded it undisturbed to a friend for microscopic setting, who remarked in reply:—"As I noticed its abdomen was very small and collapsed, I concluded it had deposited its puparium, and on examining the pieces of hay in the tube I found it attached to a small fragment; so have taken it out, and send it on to you. . . . It is at present very transparent, so I imagine the fly will not emerge for some time yet."

From the deposit taking place after the female had been secured in the tube, I was thus enabled to secure a specimen of the puparium for figuring that without doubt belonged to the Grouse Fly; but the pupa having apparently been killed by the journey, I had no opportunity of observing its changes after birth. In the very early condition in which it is figured (see p. 59), the somewhat mamillated or deeply corrugated posterior extremity of the puparium very much resembles one of the figures given by Réaumur* of the puparium of *Hippobosca equina* before it had assumed the wholly brown colour which it gains shortly after birth, and also the smooth surface and merely emarginate end of the posterior extremity of the mature puparium.

The fly (*O. avicularia*) much resembles the Horse Forest Fly in general appearance, but is smaller, not being more than a quarter of an inch in length; somewhat elliptical in shape, flattened, and tough, or leathery. The colour variable, being sometimes of a yellow horn colour, sometimes the upper side is almost brown, and sometimes the light parts are of a bright green. (In my own specimens the green tint was not present.) The head round, flattened, with two knife-

* 'Histoire des Insectes,' par M. de Réaumur, tom. vi. pl. 48, fig. 12, mém. 14. Paris. MDCCXLII.

shaped organs projecting from the mouth; antennæ very short, ciliated; eyes large; *ocelli three*, on the top of the head. Upper side of thorax depressed; suture noticeable; scutellum commonly with hairs only at the hinder edge. Abdomen obconical, hairy, more or less emarginate. Wings longer than the abdomen, of a brownish yellow tint (for neuration, see figure, p. 59). Legs hairy, each foot furnished with two claws, and *each claw tripartite*. By this formation of foot, the *Ornithomyia* is easily distinguishable from the more commonly observed *Hippobosca equina*, in which (see plate) each of the two claws with which each foot is furnished is only *two-parted*. One of these divisions being (as figured below) large, strong, curved, and pointed at the



Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata*, showing parallel grooves and saw-edge—all much magnified.

extremity; the other thicker, and much shorter and rounded at the extremity, forming a kind of thumb-like appendage to the chief division of the claws.

In *Ornithomyia* (see plate) each foot is similarly furnished with *two claws*, but each of the claws (see also figure, p. 59) is *three-parted*. Of the two larger divisions, one is long, narrow, and tapering gradually to the pointed extremity; another of the divisions is almost as long, but is thicker and almost of the same width throughout to its bluntly rounded tip. The third division, which originates at the enlarged base of the main divisions, may be described as being formed for about half its length of a narrow stem, and then rapidly enlarged to about four times its previous width into a somewhat trumpet-shaped extremity (see plate).

The subordinate and very elaborate minutiae of the foot apparatus, which, in the main points (though not quite precisely in the size and form of some of the details), correspond with those of the foot of

H. equina, will be much better conveyed by comparison of the two plates than by description. The pads, or *pulvilli*, and the very long hairy bristle (*empodium*),* are present in each case; but from differences in microscopic setting the details are in some respects more clearly displayed in the figure of *Ornithomyia*. In regard to the pads, of which *both* are well shown in *Ornithomyia*, although from an unavoidable circumstance one only is given in *Hippobosca*, and also the bristly *empodium*, I believe there can be no doubt; but besides these, both in the Grouse and the Horse Forest Fly, there is a sort of flat flap placed apparently above and between the two claws, with lines radiating from the centre to each side,—this is largest in the Forest Fly's foot,—and there appears to be clearly connected with a bulb-like process (see plates). Probably dipterists may be perfectly well acquainted with this organ, but, as I have not been able to find any description which seems to correspond with it, I merely give the figures.†

The Grouse Fly (*Ornithomyia avicularia*, Linn.) belongs, as above mentioned, to the family *Hippoboscidae*, of the great division of *Pupipara*, of which some are known as Leathery Flies (*Coriacea*, Meig.), and some (popularly with us) as Forest Flies. This genus may be distinguished by the following characteristics from the others of the *Hippoboscidae*. It possesses *three ocelli*; it has on each foot two claws, of which *each claw is three-parted*; and also the wings, which are of the *ordinary proportion of width, are longer than the abdomen*.

Thus *Ornithomyia* is distinguishable:—

From *Hippobosca* (parasitical on horses and cattle), which has *no ocelli*.

From *Olfersia* (parasitical on birds), which has also *no ocelli*.

From *Stenopteryx* (parasitical on swallows), of which the wings are very narrow, being scarcely more in width than one-sixth of their length, and are pointed at the extremity.

From *Oxypterum* (parasitical on swallows), which much resembles *Stenopteryx*, but has *no ocelli*.

From *Lipoptera* (= *Lipoptena*) (parasitical on deer), which has *two-parted claws*.

From *Melophagus* (parasitical on sheep), which is wingless, and has *no ocelli*.

From *Braula* (parasitical on bees), a very small kind, which is wingless and also eyeless, and without *perceptible ocelli*.

* "Pulvilli . . . are membranous pads, one beneath each tarsal claw; . . . the *empodium* often exists between the two *pulvilli* of each tarsus. The *empodia* may be bristle-like, or tapering, or membranous, resembling the *pulvilli* in form."—'Manual for Study of Insects,' p. 420, chap. xix. (Diptera), by John Henry and Anna Botsford Comstock. Ithaca, N.Y., U.S.A.

† In my Nineteenth Annual Report I have entered in much detail on the life-history and peculiarities of structure of various species of *Hippoboscidae*, with very full references to the writers cited, pp. 95–118.

In the above short attempt at differentiation, I have adopted the characteristics given by Dr. J. Rudolph Schiner, in his 'Fauna Austriaca: Die Fliegen (Diptera)' ii. Theil, pp. 644-650, as being the best guide which I am personally acquainted with, through the perplexities of synonyms of many previous writers.

The following short observation of habits of the Grouse Fly was kindly sent me by Dr. W. Somerville, Professor of Agriculture of Cambridge University:—"I am glad to see you have taken note of the Grouse Fly, a creature that has often attracted my attention. In warm weather in August, when one lays Grouse out to cool (as, for instance, during lunch), one has frequently the chance of seeing the fly. It generally runs, but occasionally flies a foot or two, and it is astonishing how rapidly it can disappear amongst the feathers of a bird. It is also very apt to run up one's sleeve, a not very desirable characteristic."

Besides the usually observed habitat amongst the feathers of the Grouse, I have a note from Mr. O. E. Janson, F.E.S., with which he favoured me on September 21st in the past season, that, "Strange to say, I have just obtained a very good specimen, which we found alive in a box with a specimen of the Long-eared Owl (*Asio otus*), which had been sent from the north of Scotland."

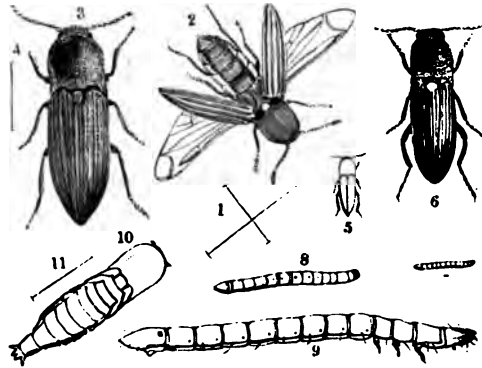
A much more remarkable locality was given in the case of a specimen sent to myself on September 18th from Swansfield House, Alnwick, by Mr. E. G. Wheler, which was found on a Lamb. In this instance I conjecture that from some cause or other the fly had dropped from a Grouse to the ground, or possibly developed from a fallen puparium (as it was a very perfect specimen), and had sheltered in the Lamb's wool as being temporarily at hand.

How far the presence of *Ornithomyia* on birds may be a source of annoyance to them does not appear to be recorded. From the presence of transverse slanting ridges on the side of the claw (see plate), which we know in the case of the Horse Forest Fly to have an excessive, and most unpleasant power of holding firmly to the hair when opposed to an opposite portion of the claw, it may be presumed the Grouse Fly can similarly hold firmly to the feathers. But unless the "host" was greatly injured by the presence of the infestation, or we had observations of it on the birds in a state of captivity, we do not seem to have means of following up the point. Also it may certainly be believed that if any irritation was caused by the presence of the fly, that the Grouse or other bird would not fail with beak or claw very promptly to dislodge the cause of annoyance.

I have pleasure in acknowledging all the figures in illustration of this paper as being by the skilled pencil of Mr. Horace Knight, and drawn for me from English specimens furnished by myself.—E. A. O.

HOPS.

CLICK BEETLES AND WIREWORMS—Small Brown Click Beetle, *Agriotes obscurus*, Linn. Pasture Click Beetle, *Agriotes sputator*, Linn. Carnivorous Wireworm Beetle, *Athous rhombeus*, Ol.



AGRIOTES sp.: 1 and 2, *Agriotes lineatus*; 3 and 4, *A. obscurus*; 5 and 6, *A. sputator*, natural size and magnified; 7, Wireworm of *A. sputator*!; 8 and 9, Wireworm of *A. lineatus*, natural size and magnified; 10, back of pupa of Wireworm, magnified. Lines show natural length.

During the past season more than ordinary amount of enquiry was sent me regarding treatment for prevention of Wireworm attack, together with requests for leaflets on the subject. The applications began about May 20th, and continued for the most part daily, and ranging sometimes up to as many as five or six a day for about a month, occasional applications continuing for some weeks or longer. Amongst these communications, however, little information was given that has not previously been fully entered on,* with the exception of an easy and successful method of trapping "Click Beetles," the parents of the Wireworm, and thus much lessening the amount of propagation; also a good observation of a kind of Wireworm which has been recorded as of carnivorous habits, being captured in the act of gnawing its way through the abdomen of a recently developed "Vine Weevil" (*Otiorhynchus sulcatus*); and likewise I was able to add some observations, of effect, or non-effect (as the case might be), of different kinds of cake on Wireworms.

The short but very useful observations on trapping were the result of some experiments carried on by Messrs. G. Webb & Co., of Tunstall,

* See more particularly the Special Report on Wireworms from contributions by leading British Agriculturists, in my Annual Report for 1882, pp. 22-63.

near Sittingbourne, Kent, and kindly sent me on May 27th. A consignment of about a hundred and twenty-six beetles was forwarded to me with the information that they had been caught under pantiles in a Hop-ground at Wingham, Kent, and enquiry was made as to whether they were all the Click Beetles which produce the Wireworm attack. These they all proved to be, with the exception of about three specimens of a "Ground Beetle," easily distinguishable by its much larger size, broader shape, and black colour.

The Wireworm Beetles are easily known by being very narrow in proportion to their length, and also by their habit when laid on their backs of regaining their position with a sudden spring, accompanied by a clicking sound, whence their common names of "Skip Jacks," or "Click Beetles." Most of the specimens sent were of the common "Small Brown" Click Beetle, *Agriotes obscurus*, Linn. This is about the third of an inch or rather more in length, the breadth about a quarter of the length, and the shape as figured (magnified) at "8," p. 64. The colour of some shade of brown or pitchy, sometimes with the thorax dark, and the wing-cases lighter or darker, but so clothed with short thick ochrey or brownish pubescence as to give the beetles a general dingy brownish appearance whilst still in unrubbed state.

Besides these, there were about a dozen or more of the "Pasture Click Beetle" (*Agriotes sputator*, Linn.), which is also a common kind, but rather smaller than the above, being from about a fifth to a quarter of an inch in length. It is not unlike *obscurus* in colour, being blackish or brown; sometimes, however, it is wholly tawny, or has the head and thorax (excepting the hinder margin of the latter) black. When fresh it is thickly covered with greyish down.

Both of the above kinds are very common, and are to be found in beetle state in summer *under stones*, on grass, in pasture lands, on hedges—in fact, generally distributed.

The Wireworms, or larvæ, of these and various other species of *Elateridæ*, or Click Beetles, are very well known by their elongate narrow cylindrical shape, and hard yellow shiny coats, altogether resembling a piece of wire of about half an inch, more or less, in length, and less than a sixteenth in breadth. The eggs from which Wireworms hatch are yellowish white and exceedingly small, and are laid in the earth near the plants on which the larvæ will feed, or it may be in some of the leafage near the root, and the duration of the life of the worms may be as much as five years.

As a very special locality for egg-laying, (and one from which the consequent Wireworm infestation is widely spread in agricultural operations), is the surface of grass fields, the method of forestalling attack by preventing egg-laying in such situations has long been known; but the plan of trapping the beetles themselves has not, I

believe, been previously brought forward. In localities where it could be carried out, as above-mentioned, in Hop-grounds, and also in Strawberry-grounds, or in gardens where Wireworm infestation may be found to occur yearly, and the field deterrents for egg-laying cannot be applied, the above plan of trapping by laying pantiles, or probably a great many other materials, under which the Wireworms would find a dark shelter, and from which they could at intervals be removed and destroyed, would probably act very serviceably.

I should perhaps mention that on applying to Messrs. G. Webb, of Tunstall, for their permission to draw attention to the successful treatment, they kindly gave it me, with the *proviso* that they must disclaim all originality in the idea, which they believed originated at the conference of Hop-growers at Wye, and that their part of the matter was only having practically carried out the suggestion. But, any way, the observation seems to me to be too serviceable to be overlooked.

Carnivorous Wireworms.—The food of the Wireworm for the most part, or with very rare exceptions, consists of roots of grass, or corn, or succulent roots, as Potatoes, Carrots, &c., of too many kinds to be easily enumerated; but there are some exceptions to the rule recorded, and during last season I was fortunate enough to have an example sent of a Wireworm which had been taken in the very act of perforating a beetle, together with the recently developed beetle on which it was feeding.

On July 29th I was favoured by Mr. Chas. T. Druery, F.E.S., writing from Stanwixbank, 11, Shaa Road, Acton, with the following observations, accompanied by the specimens referred to:—

"I send you herewith an *Otiorhynchus sulcatus*, and I believe a common Wireworm. The weevil you will perceive is pierced through the back. I noticed the latter this afternoon climbing one of my fern fronds with the Wireworm fixed upon its back; in a few minutes the latter had evidently penetrated so far as to seriously weaken the weevil, which then fell off the plant to the ground. I lifted them, and noticed the head of the Wireworm coming out on the opposite side, and hastened to get some hot water, hoping to send you the two together, but unfortunately the worm crawled right through in the interim. If it should be a true Wireworm, we have here a curious case of two pests in conflict, if I may call it so where the weevil was a quite passive victim. Thinking the case may interest you as evidence, at any rate of 'one for the weevil,' I send you the two for inspection."—(C. T. D.)

On examining the specimens sent, the Wireworm proved to be beyond all doubt "a true Wireworm," and appeared to me to possess the chief characteristics of the larva of the large and rare kind of Click Beetle, *Athous rhombeus*, of which it is recorded: "The larva is

carnivorous, and lives in decaying trunks of Ash and Beech, where it devours the larvæ of *Leptura* and other insects." *

The general colour was pale yellowish, and along the dorsal segments, with the exception of the one next to the head, were coarse punctures, often more or less confluent, so as to make longitudinal markings. The specimen had been injured in transit, so that I could not satisfy myself that a short appendage to the terminal segment was the remainder of the "two short bifurcate cerci"; but the large and sometimes confluent punctures along the back of the larva, which are an especial characteristic of this species, were very noticeable. From such expert consultation as I could avail myself of, it seemed likely, but not absolutely certain, that this Wireworm, captured in the very act of preying on the Vine Weevil, was the larva of *A. rhombeus*, Ol., still it might be a larva of one of the other species of *Elateridæ*.

The Vine Weevil, *Otiorhynchus sulcatus*, sent accompanying, and through which the Wireworm was working its way onwards through a good-sized hole which it had pierced in the right wing-case, is only too well known as the black short-snouted weevil, with the rough wing-cases spotted with pale hairy tufts, which is seriously injurious in beetle state above ground, and in maggot state under ground, to Vines and many other plants, and its attacks are especially hurtful to Maidenhair Ferns.

In the instance sent me by Mr. Druery, the attack had evidently taken place whilst the weevil was just developed below ground, for when it reached me the specimen was still flexible and soft, so that the wing-cases were pervious to the Wireworm's biting powers, and, having once well inserted itself, the Wireworm was fairly stuck fast in the abdomen of its prey as it walked up the fern frond. The entrance-hole through the wing-case was roughly gnawed round the edge, and larger by about twice the width necessary for passage of the Wireworm.

I am afraid the above observation can hardly be utilized for practical purposes, but it is perhaps of some intrinsic interest, as an

* I quote the above from 'Coleoptera of the British Islands,' vol. iv. p. 97, by the Rev. Canon W. Fowler, from which I also give the following passage with technical description of the larva verbatim:—"The larva of *A. rhombeus* is described and figured by Schiödte (part v. p. 523, pl. ix. fig. 12); it is less parallel-sided than is usually the case with its allies, and has the segments of the abdomen a little narrowed in front and behind, so that the sides are not even; it is, however, chiefly remarkable for the fact that the dorsal scuta of all the segments, with the exception of the prothorax, which is longer and not so broad as the following, are very coarsely punctured, the punctures being large, and often more or less confluent; the mandibles are very strong and projecting, and the ninth abdominal segment is large, armed with short blunt teeth at sides, and terminated by two short bifurcate cerci; the colour is pale yellowish, with the head and dorsal scuta fuscous."

authenticated record; also it might chance that where *A. rhombeus* is found, as, for instance, at localities in Sherwood Forest, or in the New Forest, &c., in *decayed wood*, that this, if infested, might possibly be used serviceably in potting-plants, as Maidenhair Ferns, for instance, that are especially subject to weevil attack.

The old idea that Rape-cake is beneficial by means of the Wireworms feeding on it until they burst was again alluded to. Relatively to this point, I am able to say that, in order to be certain that the idea was wholly erroneous, I have fed good numbers of Wireworms *wholly* on the ordinary Rape-cake, and also on the Indian or Kurrachee cake, formed of Mustard seed, for weeks together, and found that absolutely and certainly no such results followed. In each case the cake was prepared by being pounded into small lumps and dust, and moistened with water. A far larger supply was given than was requisite for food of the numbers of Wireworms experimented with, and it was placed (each kind separately) in bowls or open vessels in the open air. The Wireworms placed on the ordinary Rape-cake went into it at once, and there they fed (or to all appearance fed) for three weeks or more. After this, as there did not appear to be any use in further observation, I discontinued the experiment, but certainly none of the Wireworms burst during the above period. Some of them died, and I found that then, or when a specimen had stiffened itself in examination, that it was apt to be *cracked across* in handling, and the white contents burst out at the fracture. This circumstance may have given rise to the popular belief.

The Wireworms placed on the Mustard-cake appeared very uneasy from the stinging effects of the recently moistened Mustard, and I furnished them with a little bit of turf, and on about the fourth day afterwards they began to transfer themselves to the cake, where they (presumably) fed for about a fortnight, all of them continuing well and thriving. After this I found many dead or dying, and, though I gave them fresh turf and pieces of Potato and Turnip in addition to the cake, they all died; but *none* of them (any more than any of those fed on common Rape-cake) died of bursting. The benefit derived from Rape-cake dressings as an antidote to Wireworm mischief is in part from its effect as a manurial stimulant in supporting the plants under attack, and partly also from attracting the "worms" away from the plants to a food to which they are excessively partial; but we have no authenticated record of such inflation taking place from the food as to cause bursting.

Effect on Wireworms of Castor-oil seed cake, Rape-cake, and also of absence of food.—The following details of experiments carried on during a period of three months by Dr. Bernard Dyer (Laboratory, 17, Great Tower Street, London, E.C.), relatively to effect of Castor-oil seed cake

and Rape-cake on Wireworms, was kindly placed by him in my hands, with the remark (Nov. 14th, 1898):—"I have been trying if Cotton-oil cake (very deadly to mammals) would kill Wireworms. The experiment is a very rough one. Enclosed is a description of what happened."—(B. D.)

"*Description of experiments on Wireworms.*—One hundred worms were placed in each of three jars of earth, and fed respectively with Castor-oil seed cake, with Rape-cake, and with nothing. The cake was given in great abundance in both cases, being applied as fast as the worms seemed to dispose of it—that is to say, as fast as it disappeared, though the disappearance may not have been entirely due to its consumption as food, but partially to decomposition.

"By the end of two months about a third of an ounce of cake had been supplied to each jar. The soil in each case only weighed about ten ounces, and the cake applied must have been at the rate of far more than one hundred tons per acre; so that the experiment, even if an exaggerated one, seemed well calculated to show whether there might be any specific difference in the effects of the food supplied. The earth was of course kept equally moist in all three cases.

"At the end of three months the pots were turned out, and it was found that, of the hundred worms which had had no food at all in addition to the earth in which they lived, ninety-eight were alive, though their condition was very meagre; of the hundred worms supplied with castor-oil seed cake, ninety-three were alive and in good condition; of the hundred, however, that had been fed upon ground Rape-cake, only six were alive.

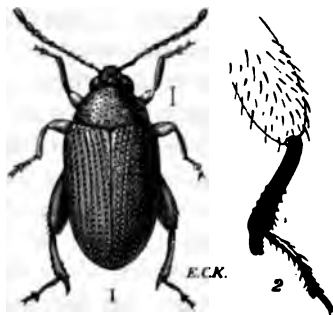
"It would appear, therefore, that Rape-cake, when supplied in such superabundance as in this experiment, brought about a large destruction of the worms, though it does not by any means necessarily follow that it would do so when used on the small scale adopted in actual farming. On the other hand, it seems to be abundantly clear that Castor-oil seed cake, although it is virulently poisonous to higher animals, fails to exercise any poisonous effect upon Wireworms, which are apparently indifferent to its acrid poison.

"Still more cake was given, but this cake, the weather being warmer, decomposed, and the soil became infested with smaller life, which seems to have brought about conditions uncongenial to the Wireworms; and it may be also that the effects of crowding for so long a time without change of soil were bad for them; for first the cake-fed ones died, and then those without food."—(B. D.)

The foregoing observations need no comment beyond Dr. Dyer's own remarks as to the presumable cause of the ultimate death of the Wireworms after the period of three months had expired, of which notes are given. But two of the special points recorded well deserve

attention; one of these is the observation that Wireworms *can exist* (although they did not thrive) for three months upon an almost infinitesimal amount of food, a fact which may be utilized for field work, as showing that, *with this pest*, leaving the ground uncropped for a time would be of no service in clearing the land of the infestation, as it is with various other of our field attacks. The experiment with the Castor-oil seed cake, showing its *harmlessness to Wireworm life*, is also a valuable record, both as a scientific fact and also as reliable authority to turn to, which may save unnecessary outlay, and also some disappointments in field experiments as to preventive treatment for Wireworms.

Hop Flea Beetle; Hop-cone Beetle. *Psylliodes attenuata*, Koch.



PSYLLIODES ATTENUATA.—Beetle, and hind leg, magnified.

The attack of the Hop Flea Beetle, or, as it may quite as correctly be described, the Hop-cone Beetle, is one which it may be serviceable to draw attention to, as it is at times very injurious in Hop-gardens in maggot as well as in beetle condition. In the beetle state it does harm by feeding on the leaves and shoots of the young growing bine, and in maggot state is mischievous by feeding in the scales or bracts of the cones.

In regard to the beetles, the first observation that I received of them was on April 22nd, 1882, when specimens were sent me from Kingsnorth, Kent, by Mr. T. H. Hart (who was a trustworthy agricultural entomologist), with the remark that this kind might be considered "*the*" Hop Flea of the district—the damage caused by the "Tooth-legged" or "Brassy" Flea Beetle being small in comparison. He further noted that nine-tenths of many hundreds taken in Hop-gardens proved to be of this species, but that at a distance from such gardens he had seldom found it.

Since then I have had no further notice of the attack of the beetles

until the notes of the mischief they had been causing on Hops were sent me (see p. 72 following) from near Hereford in May of the past season.

These beetles very much resemble many others of the great division of "Flea Beetles," of which the Turnip and Cabbage Flea Beetles are only too well known, and like them they have the thighs of the hind legs much enlarged and formed for leaping, but are distinguishable (as figured at p. 70) by the foot of the hind legs being appended, *not* at the tip of the shank, but a little way above it. The Hop Flea Beetle (*P. attenuata*) is elongate ovate, rather than oblong ovate, in shape, somewhat over a line in length (two and a third to two and three-quarter millimètres), brassy or greenish brassy in colour, with the tip of the wing-cases to some degree of a reddish tint, and these about three times as long as broad, with deep punctured striæ, the spaces between also distinctly punctured. The head small, "with two distinct furrows between the eyes which cross one another and form an X"; legs somewhat reddish, with the hinder thighs and the base of the foremost and intermediate thighs dark.

The great distinction of *Psylliodes* from the other allied genera, however, consists (as mentioned above) in the hind pair of feet (*tarsi*) being inserted, *not* as is commonly the case at the tip of the shank (*tibia*), but a little way up; and by this, with the presence also of the X-shaped mark on the forehead, which is commonly although *not* invariably present, *Psylliodes attenuata* may be clearly recognised. It is of a good deal of convenience to bear these distinctions in mind in identification of Hop Flea Beetles, as there is another kind, *Plectroscelis concinna*, Marsh. (the *dentipes* of Koch), known popularly as the "Tooth-legged" or "Brassy" Flea Beetle, which occurs on Hops, as well as Turnips, and much resembles *P. attenuata* in general appearance.

The distinction of this species (*P. concinna*) is that it has a tooth on the outer side of the shank of both of its two hinder pairs of legs, whence it takes its name. It is smaller than *attenuata*, being from rather under to rather over a line in length, of a less elongate shape, and, though resembling in colour, is more of a bronzy tint, and is black beneath; the legs also differ in having more or less of the shanks and feet dark.

As *attenuata* especially frequents Hops, and *concinna* is one of the Turnip as well as Hop Flea Beetles, the distinctions between the two kinds are of some importance in agricultural service.

On May 15th I was favoured by the following observations on presence and method of injury of the beetles of the species *attenuata* to Hops, sent me from Buryhill Lodge, near Hereford, by Mr. Geo. Bonnor:—

"I have seen these beetles on the Hops several years ago, but they never did any damage before last year, only on the leaves when two

or three feet high. Last year they got on the young shoots, and stopped their growth altogether. In a yard where I generally have ten or thirteen tons, I only had a little over three, through their puncturing them so.

"I put flower of lime, soot, and sulphur in a fine powdery condition on them, all to no purpose. . . . This year I have washed them with a strong solution of soft-soap and quassia and half a pint of paraffin, all to no purpose, as they were as thick as ever next day, seventy or eighty on one root. The best thing to keep them off that I can find out up to the present time is to keep powdering them with basic slag, put on through coarse bags.

"I may say it was only one other yard besides mine that was affected last year; this time five or six all round here. . . . I think the mild winters that we have had lately have something to do with them being hatched out earlier than usual. They do not seem to hurt the Hops when they have a fairly good start."—(G. B.)

Amongst points of interest in Mr. Bonnor's notes, one that it seems to me might very likely be utilized practically is the observation that the beetles appeared again in such great numbers (as many as seventy or eighty on one root) the day after they had been cleared by such a very stringent application as a wash of soft-soap, paraffin, and quassia. As Mr. Bonnor's washing must have been applied some time before the date of his letter to myself (May 15th), this renewal of attack must in all probability have arisen from beetles that had wintered at the roots of the Hops, and from beetles developed from maggots which had fallen from *their regular feeding places* in the cones of the Hops in the previous season, and had then gone through their changes to beetle state in the earth or in rubbish on the surface, and appeared (old and young together) in a similar manner to the Turnip Flea Beetles early in the season.

Mr. Bonnor mentions the attack as having been gradually increasing in the Hop-grounds mentioned during the last few years, and the localization of the headquarters of the spring origin of the attack may help us very much towards getting rid of it.

The following information is given by the Rev. Canon Fowler * with regard to egg-laying in the Hop-cones and hybernation of the beetles:—"The beetles get into the cones of the Hops and deposit their eggs, and the larvæ when hatched burrow through the bracts of the cones, and make them lose colour and become disintegrated; the chief damage, however, is done in early spring, when the Hop-bines are just sprouting, by those beetles that have hybernated in the old

* 'The Coleoptera of the British Islands,' by the Rev. Canon Fowler, vol. iv. pp. 388, 389 (which see also for full description of beetle).

hollow, dead bines and other refuse; it is therefore most important that all rubbish should be removed and destroyed."—(W. W. F.)

The damage caused by little white maggots feeding in the Hop-cones until, as above described, they lose colour and become disintegrated is at times a subject of serious complaint.

In September, 1882, Mr. Goodwin, writing from Cranch, near Maidstone, mentioned, with regard to this small white maggot, that it pierced into, or rather was bred in, the strig or stalk of the cone or flower, where it eats its way up the inside of the stalk, thus causing the Hops to wither and turn brown. The maggots varied in number in one "strig," but one or two were the average. In the earlier part of September these maggots were very numerous; but at the date of writing (September 27th) they had disappeared, and it was mentioned that "they drop out into the earth after eating the Hops."

Specimens were also forwarded to me by Mr. R. Cooke, from Detling, near Maidstone, of Hops similarly attacked, with the mention that the altered colour was from the attack of a maggot which channelled out a home for itself in the stem which forms the centre of the cone.

Examples of the infested Hop-cones were repeatedly sent me in 1882, and have been occasionally forwarded since; but I have never had the opportunity of technically identifying the larva so as to make quite sure that the *Psylliodes attenuata* was the cause of the mischief. At that time it was not known where this Hop Flea Beetle propagated, nor, so far as I am aware, were descriptions of the maggot attainable. But it seemed to me most likely (see my Annual Report for 1882, p. 71) that, if we could rear the maggots to maturity, they would prove to be those of this *P. attenuata*. Since then Canon Fowler's work on British beetles (quoted *ante*, p. 72) has added very greatly to our stores of useful information, and his notes on the egg-laying of the Hop Flea Beetle in the cones appear to me to leave no reasonable doubt that the injuries in the specimens sent to me from time to time during the past seventeen years are the work of this beetle.

PREVENTION AND REMEDIES.—The first points are treatment in early spring. The Hop Flea Beetles which remain from the previous season hibernate (that is, spend the winter) in any convenient shelter in or near the Hop-hills, as, for instance, in the stumps of the old dead bines or other refuse; and (so far as is possible) clearing this away will remove one source of coming trouble.

As the maggots, which in the Kentish observations were noticed feeding in autumn, *dropped from the Hop-cone to the ground*, it is obvious that these must go through their transformations at the root of the Hop, and, they being so very small and tender of structure, it would

be worth while (where the pest appears to be establishing itself, as observed by Mr. Bonnor, p. 72) to try whether a surface dressing of some application that would be sure *not to hurt* the Hop plants might kill the beetles at the roots whilst still in larval and chrysalis condition.

Kainite sometimes acts very well in preventing development of maggots to their perfect condition, and might be well worth experimenting with.

A mixture of paraffin applied at the rate of one quart of paraffin to one bushel of dry material (as ashes, sawdust, shoddy, &c.), and given so as to thoroughly cover the ground of the hills; or, again, a wash of paraffin and soft-soap might be applied, so far as common practice or experiment shows, without any danger of injuring the Hops; and from the excellent effects of paraffin or mineral oil as an insecticide, it might be hoped that a wash of this and soft-soap given to the ground early in the year might kill the maggots or chrysalids if lying near the surface. In the experiments which were carried on in 1884 by Mr. A. Ward at Stoke Edith Park, near Hereford, by kind permission of Lady Emily Foley, relatively to checking appearance of Hop Aphis from the ground of the Hop-hills in spring, upwards of seven hundred hills were thoroughly dressed over the surface with paraffin in dry material, as above mentioned, and the plants did well during the whole time of observation recorded, which was from May 8rd until August 21st; the Hop plants which had been treated with the paraffin and dry material looked well and bore well. The experiments included the somewhat severe trial of pulling the shoots off two rows, but the stocks sent up strong shoots again *through* the paraffin dressings, thus showing that the tender young leafage was not hurt.

Gas-lime, which is sometimes useful as an insecticide, when applied as a dressing was found to be very injurious; of the various rows so treated all were weak and sickly, and one row died. From this observation it would seem that the excellent recipe known as that of Fisher Hobbs's, which answers so well to check Turnip Flea Beetle attack on leafage, might be less safe here. This, as it will be remembered, is composed in proportions of a *bushel of fresh gas-lime* to a bushel of fresh lime, and smaller quantities of soot and sulphur.

In Mr. Bonnor's notes of his remedial experiments (see *ante*, p. 72) he mentions that he applied "flower of lime, soot, and sulphur in a fine powdery condition, but all to no purpose"; but he does not mention the time of day of the application.

With all powder dressings applied to check Flea Beetles, it is very important that they should be given in morning or evening when the dew is on, or when, from weather influences, the leafage is damp, so that the dressings may adhere to the leaves and to the beetles, and

thus be an effectual check on their operations. The only application which Mr. Bonnor mentions as being of some service is that of "basic slag."

In a short bulletin by Prof. Clarence M. Weed, Entomologist of the New Hampshire College Agricultural Experimental Station, U.S.A., entitled 'Remedies for Flea Beetles,' I find the use of the two following recipes for washes, strongly advocated, after trial "on a variety of garden crops," *but I have no knowledge of what the effect might be on a kind of crop of such special nature as our Hop plants.* There is no reason to doubt that they could be safely and most probably serviceably used; but, as with all other mixtures used as washes, experiment should be made on a few plants as to the strength of wash that may be safely applied to the leafage before proceeding to use it on a broadscale.

One of these applications consists of "a spray of lime-wash made by adding a pint or more of freshly slaked lime to two gallons of water, and then thoroughly *mixing in* about half a teaspoonful of Paris-green. . . . The lime dries on in a firmer coating than when simply dusted on, and consequently is more effective."

A still more certain remedy (Prof. Clarence Weed remarks) is found in the use of the Bordeaux mixture, for which he gives the following recipe:—

"Dissolve five pounds of copper sulphate (blue vitriol) in two or three gallons of hot water in an earthen or wooden vessel. Pour into a barrel, or tank, holding fifty gallons, and add water enough nearly to fill it. Now slake five pounds of good *fresh* lime in two or three gallons of water, and pour into the barrel, straining through a sieve as it goes in. Mix the two thoroughly, and the preparation is ready. In applying for Flea Beetles, or to any crop which is liable to injury by insects, add four ounces of Paris-green to each fifty gallons of Bordeaux mixture."—(C. M. W.)

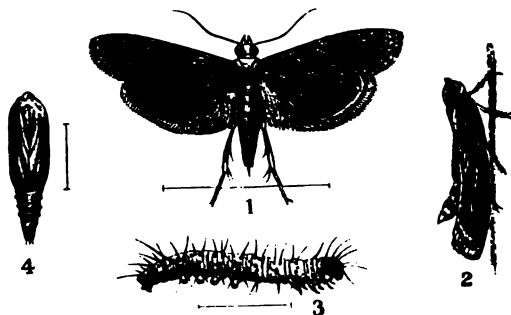
The small amount of Paris-green suggested as an addition to the lime-wash, and also to the Bordeaux mixture, which is customarily used as a "fungicide," would be certain to make the action in either case much more surely destructive to the Flea Beetles; and Paris-green, or Emerald-green, as it is sometimes called, has now been for so many years in use with us as an insecticide that it is not perhaps necessary to continue to repeat the warnings that care is requisite in using it, as it is a *poison*. It is an arsenite, or aceto-arsenite of copper, and of a beautiful green colour, making it very attractive to children; and to save risk of accidents, whether to children or from carelessness generally, the green powder should always be kept under lock and key, and only given out when needed, and into trustworthy hands.

In regard to its application. The date mentioned of appearance of the Hop Flea Beetles on the leafage or young shoots of the Hop is

(see *ante*, p. 72) April and the early part of May, whilst the shoots are still young and tender, and by many weeks before the season of even the beginning of the formation of the cones, consequently there is not the slightest possibility of the application doing harm to the crop. Trial, as mentioned above, would be necessary to ascertain what proportion the Hop leafage would bear safely, and (this being clearly known) the applications might be, after similar trial, found serviceable in other cases of crop "Flea Beetle" infestation, for which we are much needing to know of some broadscale applications.

MILLS.

Mediterranean Mill Moth. *Ephestia kuhniella*, Zell.



EPHESTIA KUHNIELLA.—1, moth, with wings expanded; 2, moth, at rest; 3, caterpillar; 4, chrysalis—all magnified, lines showing natural length.

This very seriously injurious flour mill infestation has been continuing to spread, until now it is widely prevalent in England and Scotland, and also to some degree in Ireland; and, though some remedial measures lessen to *some degree* the presence of the pest, I believe I am right in saying that none of these can be applied without risk of some sort or other, as to affecting condition of the flour, or of the mill apparatus, and also entailing much trouble, and, at times, considerable loss from temporary stoppage of mill working.

The matter has often been entered on in my preceding Annual Reports since 1888, in the autumn of which year the first complaint of observation of the infestation as a serious mill pest was sent to myself; but now in the serious difficulties from its presence, and also, as still in some instances the nature of the attack does not appear to

be fully understood, I think it may be of use to give the main points of the subject brought up to date, including amongst these, first, notes sent me in the course of the past year showing the prevalence of the pest, and the very great difficulty of bringing remedial measures really and practically to bear on the matter, and afterwards detailed descriptions of the appearance of the moth, egg, and caterpillar; also life-history and habits of the infestation, its regular and its occasional food, the countries where it is known to exist, and likewise means of prevention and remedy which are recommended.

So far as material allows, I have described from reports placed in my hands from the commencement of the attack in 1888 in our own country (as this infestation is one that is affected by temperature), but have also quoted (referred to as occasion requires) from the admirable Monograph of Mons. J. Danysz, Director of the Laboratory of Pathology of the Bourse de Commerce, Paris; from the information given in publications of the Department of Agriculture of the U.S.A., and other sources.

The following communications, which were sent me in the past season referring especially to the great spread of this flour mill scourge, were forwarded to me by millers working roller mills on a large scale, and, being in business confidence, I am not permitted to give names or localities.

It will be seen that the first observations mention the spread of the "scourge," until now it is "troubling most millers of the United Kingdom"; and also what (so far as I can venture to think myself able to understand the bearings of the matter) I believe to be a great factor in this general spread—namely, the systematic concealment of presence of attack, the complete secrecy (so far as is possible) which is preserved by those troubled with the pest. Thus all concerned lose much help that might be given by consultation and comparison of experiments, and also debar themselves from the protection from transmission of infestation which would be given if general presence of the pest was acknowledged, and sacks, bags, and similar vehicles of flour transport were, as matter of course, disinfected. Notes are also given as to *why* various methods of prevention and remedy usually recommended for mill use fail in their effect, or do mischief coincidentally, as, for instance, by fumigation tainting the flour, and of flour if subjected to the influence becoming a wet mass.

The notes were sent me, after some correspondence, on May 20th in the past season, and I give them verbatim:—

"In reference to the scourge of moths at present troubling most millers of the United Kingdom. . . . Of course the millers do not wish their customers, or, indeed, anyone, to know they have the moth pest, and on that account they will not even communicate to

each other on that matter, lest the travellers should give the information to the customers, and much damage be done thereby.

"However, hardly a miller has escaped without them, and we and other two millers in . . . have had to take down almost the whole mill machinery, and put the iron screws and other parts through fire to clean them. The best-known remedy to us is mineral oil, but this of course does not get at the maggot, and the fly keeps away from it. However, it is a good help in keeping them from settling down. Again, it is not a good remedy in a mill, so much use of oil; it is dangerous for fire, and you must keep it out of the way of flour passages; only external use. Irish lime is no use in a short time.

"We can only keep the infestation under by laborious cleaning, and this at a big sacrifice of flour. Mr. Henry Simon, of Manchester, the chief milling expert of Britain, has been applied to many times by millers, and cannot give any safe advice on the matter."

A sample box containing specimens of the moth and maggot causing the trouble referred to above was forwarded to me by the writer, showing plainly that the infestation was that of the "Mediterranean Mill Moth" (*Ephestia kuhniella*).

On May 27th the writer further continued:—

"With respect to the treatment of white-washing with fresh-slaked lime and oil, that is our chief work with the fumigation by means of sulphur in tubs in different parts of the mill, and all the doors and windows closed, but this does not get to the inside of rhones and screws, where they live chiefly. We are not troubled in our Wheat stores, it is only in our roller mills, where the Wheat is ground and dressed into flour, and they seem to propagate and thrive in the inside of flour rhones, collecting-bins over the top of rollers, and in the seams of the wooden floors, though there we get at them easily and destroy them. Semolina in passing down rhones will sometimes receive the eggs or germs of life, and after sitting for a few weeks in the sacks will develop the maggot, which gathers a kind of fibre around it, even in the centre of the sack. In flour also you will find it indicating that it can live seemingly excluded from the air.

"In the matter of steam, we have a three-inch pipe going up through all our flats, with an opening to each flat, but this is only to be used in case of fire. However, we tried it once during an alarm of fire, and it did great damage to the silk cloths for dressing, and in turning the dry flour in rhones and screws into paste, through the condensation of the steam.

"The test of heating the Wheat up to a temperature which would destroy the eggs or germs of life seems a very easy plan, and while the arrangement might be a little expensive at first, it might be the most economical in the end. From the time we lift our Wheat ex-ship in

sacks, they are never emptied till the Wheat is being put on the mill. I understand that many of the mills in England and two or three in Scotland have adopted a plan of washing all their Wheat first, and then subjecting it to a high temperature (safe) before it goes on to the cleaning machinery; but I have not yet learned if this has been a preventive of the moth pest. It was not put in with that intention, but as a means of obtaining better results in the manufacture of flour.

"I have great fears of handling poisons through inexperienced men, and warm flours—Semolinas and offals—are so powerful in absorbing odours near them—even in the outside court the smell of asphalt has been taken in by flour three flats up in store. You will notice that our case is the dealing with the products of Wheat in its different stages of Wheat-meal, flour, and cattle feeds, not Wheat; we have no trouble there, though if we could kill in the Wheat what afterwards troubles us in the ground meal and flour stages it would be well."

The following communication turns chiefly on the great loss (even to the extent of necessitating "tons of the spun flour" being burnt) which ensues on this moth attack being allowed to gain possession. The observations relatively to bisulphide of carbon refer to my mention that fumigation by this means was *the especial* remedial agent recommended by the Department of Agriculture of the United States; but at the same time I most forcibly requested my correspondents would note the risks attending the application—namely, the excessive inflammability of the vapour, not only in case of presence of light, but also (as I have myself seen take place) of ignition occurring merely from raised temperature; and likewise the very possibly prejudicial effect of the vapour of the bisulphide to the health of those who might be exposed to it, unless due care in subsequent ventilation was exercised. The communication was sent me on Dec. 5th, 1899:—

"We are flour millers, with a modern roller mill, which works automatically, that is, the Wheat is put in at one end of the mill, and, although in process of manufacture it is turned into dozens of different qualities of material, each is conveyed from one machine to another by spouts, elevators, screw conveyers, &c., and is not handled till each finished quality arrives at its packer.

"Lately we have had several lots of flour returned to us, our customers complaining that the flour was full of maggots, which, on examination, we found was the fact.

"We then had a thorough examination of our mill, and found every one of the spouts, conveyers, elevators, and machines simply alive and grown up with maggots and moths, samples of which we send you under separate cover.

"We should like your opinion as to the origin of these maggots

and moths. Are they native, or have they come from some foreign country, say in the Wheat? (We use Wheats from all parts of the world.) How are we to get rid of them, and kill the eggs? In answering this please note that nothing with a strong smell can be used, as flour takes a smell from anything very easily.

"We may tell you that our mill has been working for the past twelve years or more, and until now we have never seen the slightest sign of a maggot or moth in it."

On Dec. 8th, after some preliminary observations relatively to my reply to their enquiries, my correspondents further remarked :—

"At present we are continuing cleaning the mill as best we can, and have taken tons of the 'spun flour' and maggots out and burned them in the furnace.

"We are going to consult" [here the name of a well-known chemist was given.—E. A. O.] "as to whether he understands and will undertake to fumigate the mill with bisulphide of carbon, or can get us someone who does understand it. If he cannot, perhaps you will assist us. However, before doing anything further in this direction, we will have to get the permission of the insurance companies, as it might vitiate our insurances.

"Of course our mill is entirely stopped, and it will take us many weeks if not months before we will get started again. We need hardly tell you that this is a very serious loss.

"We have no objection whatever to your publishing the facts of the case, provided you do not mention anything to identify it with our mill."

In regard to the appearance and habits of *Ephestia kuhniella*, the moth may be generally described as of a grey colour, with the fore wings, which are about seven-eighths of an inch in expanse, of a grey-ground colour, with various lighter and darker markings, and the hinder wings of a dirty white. But for technical reference I give the detailed description by Mons. Danysz, quoted from his work, referred to below* :—

"Distinctive characteristics of the species.—The *Ephestia* is a moth of from ten to fourteen millimètres in length" [two-fifths to rather less than three-fifths of an inch.—E. A. O.] "and of a more or less decided grey. The head is of a deep tint, and bears long antennæ. The thorax is clouded with grey and black; the abdomen is greyish. The upper wings are of a rather deep grey with some white dots. The hinder edge of these wings bears a series of black dots, in line one

* '*Ephestia kuhniella*, Parasite des Blés, des Farines et des Biscuits. Histoire Naturelle du Parasite et Moyens de le Détruire.' Par J. Danysz (Directeur du Laboratoire de Parasitologie de la Bourse de Commerce). 'Mémoires du Laboratoire de la Bourse de Commerce.' Paris. 1893.

after the other, and which sometimes are enlarged into a kind of small discs. These black dots form by their aggregation a black line edging the well-developed fringe with which the wings are ornamented. The upper surface of the wings is marked with numerous irregular black spots, which form two transverse lines, more or less interrupted and indented, and on the disc is an irregularly-shaped crescent-like marking. The lower wings are of a dirty white; the veins are grey, with a band of a deeper tint bordering the fringe.

"The egg is white, ovoid, visible to the naked eye; its smallest dimensions are 0.30 mm. in length to 0.20 mm. in width; the very fine shell bears on its surface small elevations, arranged in stars, which are very characteristic. The egg of *Ephestia* does not pass the numbers of bolting silks ('soies à blater') higher than No. 70."—(J. D., *loc. cit.*).

The caterpillar (*larva*) may be shortly described as about half an inch in length, of rosy white or sometimes of a rose colour. The head reddish or yellowish brown, and a dark patch on the top of the segment next the head, and also a dark-coloured plate on the caudal segment.

In 1888 I had opportunity of first examining larval specimens, and found the details of samples sent me from an English mill, of which the moths accompanying proved on comparison with type specimens to be the true *Ephestia kuhniella*, Zeller, as follows.

The caterpillars varied in size from two-eighths up to five-eighths of an inch in length, and correspondingly in colour, the younger ones being of a flesh or pale red colour, and the largest almost white; the shape cylindrical, somewhat slender, with sixteen feet—that is, three pairs of claw-feet, four pairs of sucker-feet, and also a well-developed pair of sucker-feet beneath the tail segment, by the help of which, although the largest of the larvæ were sluggish, the younger travelled nimbly, and could move backwards or forwards at pleasure, or were able to attach themselves at once to a foreign substance, as the finger or hand.

The head yellowish brown, darker in front, and with dark brown jaws; a transverse patch on the segment next the head, this rather pale yellowish brown in my specimens (but the depth of tint apparently variable) with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch.

Along the back, excepting towards the head and tail, were four small dark dots on each segment above, two on each side the centre. On the segments near the head, the spots were arranged more transversely; and at the tail extremity, immediately above the sucker-feet, was a brownish oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat

in different specimens; the largest was in the middle, with a smaller one on each side, and occasionally one below, making five altogether; but sometimes the lowest pair was absent; sometimes the middle large spot was not entire, conjecturally the marking differed with the age of the caterpillar. On the preceding—that is, the eleventh—segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment.

The caterpillar was slightly sprinkled with pale hairs, or fine bristles, and had such a capacity (consequently) for catching and retaining a covering of flour, that I was obliged perpetually to remove it with the moistened tip of a finger in order to obtain a clear view of the markings.

The chrysalis (which lay in a silken cocoon of spun-up flour) showed the chief points of the form of the coming insect plainly; the colour was that of beeswax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged, slightly curved tail, which ended bluntly or cylindrically; the eyes were of a darker shade of red.

I had not the opportunity of observing how long the chrysalis state lasts before development of the moth, but it is stated by Prof. Zeller that the time taken is three weeks.

The rapidity of succession of generations of *Ephestia* is influenced by temperature; where this is favourable, as in mills working day and night, it is found that there may be *five* or six successive generations yearly.*

The method of life is for the minute maggot, which is almost invisible to the naked eye when it comes out of the egg, to begin immediately to spin a fine glutinous silk, or web, so tenacious that it adheres firmly to the smoothest surfaces, and thus the bolting apparatus, woodwork, machinery—in fact, everything that the caterpillars can get at—become covered with a thick coating of whitish web, with grains of flour or meal attached. As the maggot (larva) grows—which it does so rapidly that in three or four days (unless the weather is not too cold) it is a line in length—it remains within the sort of “felt”-like web as long as food is in reach; but when this ceases to be the case, it comes out and spins a new layer of web on the top of it, and this process is continued until great masses are formed of the spun-together flour. In my own experiments I have seen flour felted by a colony of *Ephestia*, which I kept under observation, into a mass ten inches long by six wide and about an inch deep, this mass being webbed firmly together throughout. On the broadscale and widespread amount of observation which it was in the power of Mons. Danysz to carry out, he mentions having seen these spongy, elastic spun-up masses measure several “metres” in length. As a “metre” equals

* See '*Ephestia kuhniella*,' by J. Danysz, pp. 10–14 (referred to in note, *ante*, p. 80).

thirty-nine English inches in length, this will convey to those unacquainted with the importance of the subject some idea of the mischief caused in milling operations by continuous yards of felted-up flour.

In one of my earliest reports from steam mills in the north of England, the miller put the matter shortly:—"They get into the spouts and machinery, and do no end of mischief, both by destroying the silks, and stopping the flow of flour, &c."

But where once the infestation gets even a slight foothold, thorough possession follows very rapidly, as shown in the following extracts from the exhaustive report kindly placed in my hands by the Department of Agriculture, Ontario, Canada, whilst I had the honour of being in communication with them on the infestation on the occasion of the first appearance of *E. kuhniella* in that country.* The locality was at some large steam mills in the Province of Ontario.

The first appearance of the moth, so far as known, was during the month of March, 1889:—

"The moth was seen flying about near a steam-pipe in the basement of the mill, but little attention was paid to it. In April there was an appearance of a few moths on the different floors of the mill, even at the top, but still there was nothing suspicious.

"In the month of May we were troubled with a few worms in some of our goods, and in June more of them appeared. In July they increased rapidly, and then we began to suspect they were from the fly which we had seen in the mill during the previous months, and which were steadily increasing in numbers.

"About the middle of July we shut down for a day or so"; and details are given of treatment of clothing from bolting-reels and of elevators. Then every corner and part of the mill having, *it was supposed*, been thoroughly cleaned, work was commenced again, and after about four days, bolting-reels, elevators, &c., were found worse than before. They were literally swarming with webs, moths, and worms, even inside the dark chambers of the reels. "We shut down again, and made a more thorough cleaning by washing, &c.

"While this was going on, we found there was no use to try and clear ourselves of the pest, as the mill walls, ceilings, cracks, crevices, and every machine was completely infested with moths, cocoons, and caterpillars, and there was no use going on. . . . The moth was different to any of which we had had any knowledge or experience, and we decided to apply to the Dominion Government for relief and assistance."

The Dominion Government having happily on their staff thoroughly efficient advisers, both scientific and practical, in the persons of their

* See 'Bulletin 1, Provincial Board of Health of Ontario': "The Flour Moth, *Ephesia kuhniella*." Issued by the Ontario Department of Agriculture.

Entomologist and Director of the Experimental Farm Stations, and the exceedingly stringent measures advised *being enforced by an Order in Council*, approved by His Honour the Lieutenant-Governor, the pest was stamped out (*pro tem.*), and remedial measures arranged to be brought to bear should re-appearance be threatened. But the loss from this attack, and requisite treatment, amounted, as stated in a letter to myself, written on Sept. 21st, 1889, from the owners of the infested steam mills, to about £1000.*

The notes given at p. 79, preceding, by one of my enquirers working some large steam mills, describes the too frequent state of affairs thoroughly: "We had a thorough examination of our mill, and found everyone of the spouts, conveyers, elevators, and machines simply alive and grown up with maggots and moths, samples of which we send you"; these, as before mentioned, proved to be of this widely-distributed flour-mill scourge, *Ephestia kuhniella*.

With regard to the food of the Ephestia caterpillars.—In this country, as we know to our cost, it frequents flour, and although (from extra-British records) there is no doubt that on occasion it attacks grain, I have not, in the twelve years during which enquiries have been sent me, had a single note of it as a grain pest with us.

It is technically described by Mons. Danyasz as "the parasite of corn, flour, and biscuits"; in the United States it is officially recorded by Mr. F. H. Chittenden that "although the larva prefers flour and meal, it will attack grain when the former are not available, and it flourishes also on bran, prepared cereal foods, including Buckwheat grits, and crackers."

The injury to biscuits has not been reported with us; but in the monograph on this attack by Mons. Danyasz (previously referred to) this injury is recorded as occurring on a very large scale in France in connection with the army supplies, and amounting at times to as much as half or the whole of the store. The details and statistics of this, and the preventive measures requisite, are entered on with very serviceable clearness at pp. 23-26 of the work (previously cited).

In the case of what is considered to be the first recorded observation of the presence of the attack in this country in 1887, the moths were bred from "Rice-cones," which shows their capacity of at least infesting rice products.†

The geographical distribution of the infestation has spread so steadily since 1887, before which date it was little observed, that now it is certainly widely distributed in Europe and in North America. We

* See Bulletin referred to in note preceding, p. 83.

† I am not personally aware of the nature of "Rice-cones," but am informed, on enquiry at a baker's, that this is a name given to a form of ground Rice used for rubbing the inside of troughs to prevent the dough adhering.

know of it from published accounts as being present in Germany, Holland, and Belgium, and also at various of the Mediterranean ports. In some of the more recent enquiries sent to myself in the course of examination of samples of condition of flour from about one hundred and thirty barrels, imported from an Hungarian mill, I found (besides what was the special subject of enquiry) lumps of the clotted-up flour, which is a sign of *Ephestia* presence. Also in the case of two shipments of flour from an Adriatic port the outside of the sacks were found on landing to be thickly infested with maggots and cocoons, which my correspondent, from his own study of the subject, considered to be of *E. kuhniella*; and, so far as the specimens sent enabled me to judge, I saw no reason to doubt his identification.

In Canada it appeared as a serious flour mill pest in 1889 (two years after the date of the first recorded observation of its presence in England). In 1892 it was found present in mills in California, and in 1895 its appearance was observed in New York State. It has also been reported from North Carolina, Alabama, Mexico, Colorado, and likewise from Chile. Thus, looking at the vast area of known infestation, and the probability of a greatly increased spread having further occurred, there is a presumption that flour imports from most parts of the world are liable to be *Ephestia*-infested, though (practically, considered in the point of view of our own protection) this matter has long since ceased to be material to us in England and Scotland, from the widespread prevalence of the trouble. Up to the present date I am not aware of it being as widely dispersed in Ireland.

The rapidity of the spread of this *Ephestia kuhniella*, the "Mediterranean Mill Moth," is probably rightly ascribed to "the higher and more equable temperature maintained in modern mills, a condition highly favourable to the development of the insect" (F. H. C.).

PREVENTION AND REMEDIES.—One point on which something might certainly be done is to check ingress and egress of the pests in egg and caterpillar condition. It is not only in mills that the infestation is present, but the caterpillars are to be found in flour at bakers', and are constantly transported to and fro with eggs and cocoons in and on sacks of flour, and likewise in and on the empty sacks which have carried infested flour, and which, when sent on without due disinfection, transmit the pest constantly more and more *throughout the country*. The caterpillars have almost an extraordinary power of pervading every part of a building. In Bulletin 1, on the Flour Moth, issued by the Ontario Department of Agriculture in 1889, p. 11 (as a *working example* of this), an account is given of a large warehouse, some 25 ft. wide, 75 ft. long, and four storeys high, which became literally alive with moths in the course of six months, "while thousands upon

thousands of the cocoons were found adherent to the walls, joists, posts, ceilings, in every nail-hole, cracks in floors, partitions, machinery, furniture, throughout the whole building"; also in sample-boxes of cardboard, in small and large bags, and in flour stored anywhere throughout the building the pest was abundantly present.

On a lesser or greater scale, as the case may be, whether in roller mills, bakeries, flour warehouses, or wherever flour of the kind infested by *E. kuhniella* is stored, the pest may now exceedingly likely be found, and one preventive measure strongly advised is, where danger of introduction is suspected, to *quarantine the goods or bags in a warm place* for a sufficient length of time for the infestation, if present, to show itself, and for measures to be taken accordingly.

Also it is most strongly advised (where cause exists for suspicion) to have the consignment, whether large or small, inspected by a *qualified examiner*, and if infested refused. The presence of this kind of caterpillar may be distinguished to a great degree by their *rosy or reddish colour*. In the official pamphlet of Mons. Danysz, he notes that this is a quite trustworthy guide. In my own observations I have found the younger caterpillars flesh or pale red colour, and the largest *almost white*; but in infested consignments quite sufficient of the caterpillars would still be in the obviously reddish stage to draw attention of all concerned to the matter, and the details of appearance and habits given at pp. 81 and 82 would be quite enough to pronounce on, even for legal depositions.

If in the case of the two shipments from the Adriatic port, mentioned at p. 85, these were sent on to customers; they must have carried the infestation with them, and the *refusal of infested goods* is most strongly dwelt on in the official pamphlets of other countries now before me as an important preventive measure.

Another point is that all bags which have been used for transporting grain, flour, or meal should not be admitted unless subjected *under inspection* to thorough boiling, superheated steam, baking, or other treatment which is absolutely certain to destroy the eggs or caterpillar, or infestation in any stage, which may be within or attached to them.

In the constant traffic to and fro connected with flour sent from mills, warehouses, &c., to small depôts, especially to bakeries, there is every probability of the range of infestation being constantly increased, and I can speak from personal knowledge of the infestation in bakers' stores being allowed to continue as if it was of no consequence; and whether or not (in the constant replacement of supplies) this matters to the owner, the infested bins and storing places make a constant centre of spread of infestation to returned sacks or bags.

In cases like the above, ordinary methods of purification would be of great service—such, for instance, as use of scalding hot water,

applied to floors of bins, and wherever it could be run, as near boiling point as possible, and into all chinks and crannies, which are favourite resorts of the caterpillars; and also thorough lime-washing the walls at frequent intervals with some insect deterrent, such as naphthaline or paraffin, mixed in the wash, is an important point of treatment where the application could not come in contact with the flour.

For mill use, however, some very much more stringent remedies are needed, and at present *nothing is before the public* which answers thoroughly, or to which there is not some objection by reason of its ill-effect, without enormous care, on flour, machinery, or operators. Still, some amount of good has resulted, and I give as shortly as I can the method of application of some remedial measures which have been partially successful.

The first experiment tried (subsequently followed up on an enlarged scale in Canada) was in 1888 in steam mills in the north of England. Here I suggested the possibility of getting the infestation under by *turning on hot steam* from the engine, a plan which I knew had been perfectly successful in clearing a cheese factory of maggots which had spread into chinks and crannies to a very troublesome extent. My correspondent, acting on the suggestion, "stopped the mills for a week, and had all the machines cleaned through, and then *went over them and the walls with steam*, and then whitewashed the walls and *underneath all floors* with fresh-slaked lime and paraffin." He noted that the way he applied the steam was by carrying about forty yards of half-inch piping into the mill from the boilers, and attaching an indiarubber bore to it for the men to work about on the walls, floors, spouts, and machines, blowing the steam into all the crevices and holes. "After blowing the steam, which took two or three days, I set," he reported, "the men to work to wash the walls (and everywhere that they could without fear of affecting the flour) with paraffin; inside the machines I had washed with a strong solution of boiling water and soda. I find that strong soda and water is effectual in destroying the maggots when it can be got on them. I still continue washing and *syringing* all likely places for them to settle with paraffin, and keep a lad or two going about brushing up and killing all the moths they can see."

The result of the above was reported to be, though not a positive clearance of the pest, yet there were comparatively few moths about, and he hoped that their continual exertions would prove successful.

This steaming rusted the shafting, &c., but this was said to be quite a secondary matter, as it could soon be cleaned again; and further, where flour in sacks, &c., is so placed as to be exposed to action of the steam, it is as matter of course damped. But where this trouble is provided against, the steaming treatment appears (though

not a complete remedy) to lessen the evil to a very serviceable amount.*

Consequently on our English experiments, and after much consultation of the entomological authorities in the province of Ontario, Canada, on the first appearance of *E. kuhniella* there in 1889, careful measures of purification by steaming, &c., were set on foot in the steam mills where this mill scourge had established itself, which were detailed as follows †:—

“We took down our machinery, and subjected it to steaming. Every part was thoroughly steamed. The mill was swept down, and subjected to sulphur fumes. The walls, ceilings, &c., were cleaned, and elevator-spouts and loose wooden work burnt up. Paper bags and hundreds of dollars worth of goods were burnt in the furnace, while the other bags, elevator-belts and cups were boiled for hours in a cauldron of water. The machines and all parts that were not destroyed were then burnt by means of a kerosene torch, which flamed and smoked through and around every part of them, until we considered we had everything clean and ready for putting together again.”

These measures of purification, however, effective as they appear, were not considered to be sufficient, and an Order in Council on the subject was passed on Sept. 19th (1889), approved of by His Honour the Lieutenant-Governor, and an order was given to the steam millers that, before placing the machinery in position, it should be subjected “to a thorough disinfecting process in a strong room so arranged that steam under pressure might be drawn or driven into it.”

“In compliance with this order,” the millers reported, “we at once constructed a tight steam-box, 6 ft. wide, 6 ft. high, and 12 ft. long, and attached a steam-pipe to it from the boiler. In this box we put every machine, and even our mill-stones and iron rollers. This process was very expensive, and took up considerable time, as we were over a week at the process, and were delayed in the placing of our machinery.

“The Board of Health visited us in a body during the time the process was going on, and pronounced it a success. This was all done, not only in our own interests, . . . but in the interests of the public health and commerce of the country.

“Having now got to the position which enables us to go to work again, . . . we have arranged for remedial measures to prevent the re-appearance, or for the destruction of the pest should we ever be again attacked. We have erected a steam stand-pipe, with hose or

* See my Annual Report for 1888, p. 70.

† See ‘Bulletin 1, Provincial Board of Health of Ontario’: “The Flour Moth, *Ephestia kuhniella*.” Issued by the Ontario Department of Agriculture.

other connection, on each flat of the mill building. By shutting up all doors and windows on each flat, and turning on the steam simultaneously to each floor, the whole building can be filled with live hot steam sufficient to kill anything."

In a letter written to myself by the owners of these infested Canadian steam mills (a part of much correspondence which passed between myself and Canada on the occasion of the attack), the loss up to Sept. 29th was stated to be about £1000.

By the above measures, modified, of course, to suit the requirements of different mills, the presence of infestation can be got under; but still there follows the almost absolute certainty that it *will re-appear*, unless the most stringent measures are taken to prevent this under the superintendence of someone well acquainted with the infestation, and the signs of its presence in flour. The masses of spun-up material which are the trouble in this attack are well described by one of my correspondents as caused by a web or tissue, "which links, or rather gathers together flour and other stock, forming a sponge, which sometimes assumes such proportions that spouts are actually blocked up. They are also a trouble at the feed-rollers, as they make the feed to roller mills and other machines uneven, and might at such an injury do vast injury to the plant."

So far as I am aware, the only method of making a complete *clearance* of the pest out of an infested mill, without almost prohibitory amount of expense and trouble and publicity in the operations, is FUMIGATION.

One great advantage of this treatment is that the fumes penetrate into every cranny, and so reach the pest in its sheltering places, where no mechanical measures would penetrate to it. But, on the other hand, the treatment may greatly injure the flour left within sphere of its action, or, again, may be dangerous in the extreme from inflammability.

One plan recommended in the Canadian Bulletin, previously quoted, is to subject the affected portions of a mill or building to repeated treatment with the fumes of burning sulphur every night when the works stop. If this is persistently carried out, it is stated that little development of new forms (presumably continuation of development from caterpillar to moth—E. A. O.) will follow; but it is also stated that abundance of sulphur must be burnt again and again to ensure success.

The effect, however, of the sulphur on the condition of flour stored where it is exposed to its effect has been found to be so destructive to its suitability for bread making, that I subjoin a report received from the owner of some large steam mills as a caution to those not acquainted with the disasters that may arise.

In this case, after sulphuring had been used on a scale of *great strength*, it was noted:—"We found that the sulphuring had an effect which we did not anticipate or wish for. We had standing in the mill itself when the fumigation was carried out some eighty or one hundred sacks of flour, and we find to our dismay that the sulphur has penetrated right into these, and acted on the gluten of the flour in such a manner as to apparently break it up into soluble albuminoids, and render the dough made from it more like a lot of weak putty than the strong tough dough our customers require. The effect would be very disastrous to millers who store their flour in the same building as they manufacture it in, as some do, and in our case it has given a lot of trouble. I think you will be glad to know of this, that you may warn your correspondents against sulphuring any building containing large quantities of corn."

I particularly beg my readers will notice the above, so that the sulphuring, where carried on, may be without danger of injury, excepting to the caterpillar-infested flour; and with this caution I give what appears one of the safest methods of creating sulphur fumes noted in the Canadian Bulletin:—

"To prepare sulphur fumes.—Place a *metallic* dish containing hot ashes on some support in a pan of water, or place it in an old pan or other vessel, a bed of ashes at least six inches deep, and about fifteen inches in diameter, and place the sulphur and saltpetre in a slight depression in the centre and ignite.

"The proper proportions are three pounds of sulphur and three ounces of saltpetre per one thousand cubic feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited."—(Page 12 of Canadian Bulletin 1, previously referred to.)

"Chlorine fumes may be used with equal benefit under those conditions where burning sulphur may create an added element of danger from fire.

"To prepare chlorine fumes.—Mix in a glazed dish and place on a stove or other heating surface peroxide of manganese one part, sulphuric acid two, chloride of sodium three, water two; or more easily by mixing three pounds of chloride of lime and three pounds of hydrochloric acid for every one hundred feet of space."—(Page 14 of above Report.)

I give the above recipes by *no means on my own authority, but as advised* on what I believe to be by the thoroughly trustworthy recommendations of the Canadian (Ontario) Government in the Bulletin frequently referred to (*ante*). But I would most earnestly suggest to all millers and others connected with preservation of stores of flour that, before using these or other *chemical* remedial measures, they

should (unless they are themselves acquainted with the effects on flour constituents) lay the matter before the chemist of their firm. This is especially to be considered in the case of the following application.

Bisulphide of carbon.—This as a fumigant is, I believe, the application recommended above all others in America as successful in clearing out “Mediterranean Mill Moth” and other insect pests of stored goods (as of Beans or Peas, for instance) on which it can be brought to bear in confined areas, large or small. From the widespread prevalence of its use for many years, it is presumable that it can be used safely with ordinary care, but as yet its use has not gained footing here, and *I could not think of recommending its use myself, excepting under the advice and direction of a known trustworthy chemist.* Therefore, I do not give any recipes for the method of application. The danger is great in uninstructed hands of its excessive inflammability, causing disaster in all directions; it not only ignites from presence of light in its neighbourhood, but also at a raised temperature unaccompanied by neighbourhood of light; also its effect on the workers exposed to the vapour, before the mill is ventilated, may be prejudicial in the extreme.

OBSERVATIONS.—In the above pages I have endeavoured to give a digest, to the best of my power, of the main points which have been recorded regarding this destructive flour pest, since it came under notice some thirteen years ago, including in this—detailed description of its appearance and of its habits; its geographical distribution; *preventive measures* both requisite and easy of application to an extent to very considerably lessen amount of its presence; and remedial measures which appear to me to be at the best temporary in their action, very costly, very troublesome where consisting of mechanical treatment, and where of chemical treatment involving risk of many kinds.

These abstracts of observations, ranging over thirteen years, I have arranged from reports sent from millers in this country to myself, sometimes *in extenso*, sometimes giving the subject of their communications; also from the foreign and American works of authority on the subject; and, looking at the whole matter practically, it seems to me that the best that can be done, as shown by our own plain common sense, and those points most especially dwelt on in official reports are *keeping out the pest* so far as may be done by:—

Firstly, refusing all infested consignments of flour, great or small, from cargoes downwards.

Secondly, where there may be suspicion, quarantining the flour apart, so that no evil may spread from it until it is found whether the *pinkish Ephestia* caterpillars are present, or moths develop.

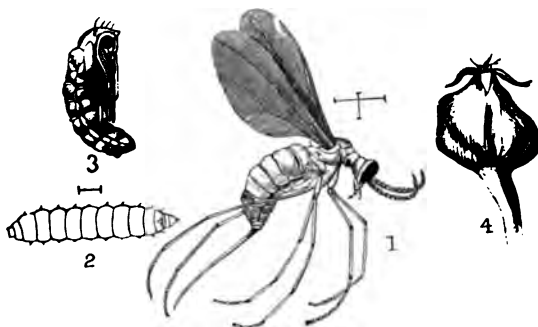
Thirdly, the vitally and enormously important point of regularly disinfecting sacks, or bags, used in transmission of flour to and fro from mills, warehouses, bakeries, &c. This in itself would greatly lessen infestation.

Fourthly, "cleanliness," as it is described; *i.e.* frequent washing of walls and every possible surface with whitewash, mixed with paraffin, carbolic acid, or any ordinary insect deterrent.

All these would help, and, while I trust that I have verified all the points suggested so carefully that I may not be thought presumptuous in bringing them forward for consideration, I should like to add that I should be truly grateful for any corrections or additions which I might be kindly favoured with, to help me to be of greater assistance in the severe cases of infestation, in which, under promise of business confidence, my suggestions are applied for; or (if desired) for preparing a leaflet for gratuitous distribution.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra*?, Meigen and Schmidberger; *C. pyricola*?, Nordlinger.



DIPLOSIS PYRIVORA.—Female, magnified; lines showing natural size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

It will be well in the remembrance of many Pear growers, that in the year 1898 the attack of the maggots of the Pear Gnat Midge was more prevalent (especially in the midlands and more southerly part of England) and more seriously injurious to the young forming Pears than in any year since 1888, when the attack was first entomologically recorded as present, although not to any serious amount in this country.

In the following year, that which is just past—namely, 1899—

scarcely any enquiries were sent me regarding the infestation, and it would not have been worth while to enter on the subject again excepting that from this very circumstance (of *non*-observation), it appeared of serviceable interest to ascertain whether the attack recurred at the localities at which it had been reported as noticeably injurious in 1898; and if not, to what circumstances or what preventive measures the non-reappearance might be ascribed.

Through the courtesy of my correspondents, who are all well qualified to report on the subject, I have been furnished with the information requested, which I give (p. 94, and onwards), appended in each case to a note of some of the points of appearance in the preceding year, and I trust it will be considered, on glancing over the summary following the notes, that we have now quite sufficient practical information before us to enable us to keep the attack of this Pear Gnat Maggot (*Diplosis pyrivora*) in check.

The Gnat, or Midge, which causes the injury is a very small two-winged fly, gnat-like in appearance, and about the twelfth of an inch or rather more in length (see figure, magnified, and lines giving natural length). The general appearance is greyish or black, but, when examined in detail, the head is black, bearing a tuft of yellow hairs; thorax black, but with some grey markings, and varying in appearance according as to whether it is looked at from before or behind. A tuft of yellow hairs placed at the root of each of the dusky wings, which are clothed and deeply fringed on the hind margins with black hairs. Abdomen dark brown, clothed with long whitish hairs; legs brown, clothed with white hairs, more dense on the upper surface.*

The method of egg-laying is considered to be that when the Pear blossom-buds are so far advanced as for a single petal to show itself, the Pear Midges deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud; but they have been recorded by one observer as egg-laying in the open blossom. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail. Within the young (or it may be said the embryo) pears the midge maggots live and feed until they have attained their full size, which may be about the beginning or middle of June, and the infested Pears may often, though not always, be known by their knobbed irregular growth and discoloured patches.

* For full and clear description of the imago or perfect Gnat Midge of *D. pyrivora*, see paper on this insect by R. H. Meade, in 'Entomologist,' vol. xxi.

At this stage—that is, when the young Pear is destroyed by the mischief within—the fruit usually cracks or falls to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or, if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting from Prof. J. B. Smith; for reference, see note below) go down to a depth “varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring.” There appears to be a difference of date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come out of the ground in spring ready to attack the blossom-buds of the Pear.*

On the above points in the life-history—that is, in the circumstance of the maggots falling to the ground from or in the fruit, and burying themselves a very little beneath the surface, where they go through their changes to the perfect Gnat-fly—the preventive measures almost entirely turn.

These mostly consist in gathering the injured fruit before the maggots are arrived at the stage at which they leave it, and *destroying* maggots and little Pears together; also of skimming the surface of the soil beneath infested trees and removing it, and burying it down or otherwise destroying it, so that the maggots within may be certainly destroyed; or dressing the surface with some application (preferably with kainite) which has been found serviceable in preventing development of the maggots.

Practical notes of the effect of this, and of some other points of treatment will be found in the following observations, and are given in the successive order in which requests for information, with specimens of the Pear Midge maggot accompanying, were sent me in 1898, thus (taken together with the reports of 1899, appended *seriatim*) affording a usefully interesting view of the effect of such preventive measures as were carried out.

On May 18th, 1898 (the earliest date of enquiry as to attack then in active stage sent me), I received the following enquiry from Mr. H. H. Williams, of Pencalenick, Truro, Cornwall:—

“Could you kindly tell me if it is possible to prevent the attacks of the insect which has got into the young Pears I enclose? Last

* See, for much useful information on this attack, “The Pear Midge (*Diplosis pyrivora*, Riley),” Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

year I picked and burnt all diseased fruits, and this year it does not seem quite as bad. I noticed that one lot of trees which was heavily limed on surface (quick-lime) last autumn have not suffered nearly as much as another lot which were not dressed with lime.'

On May 16th, 1899, in the past year, Mr. Williams was good enough to forward me the following notes, with specimens again accompanying, as confirmatory of the attack being certainly that of *D. pyrivora*. It will be seen from the observations that the amount of attack was very much lessened by the treatment of dressing with kainite, and of picking and destroying all diseased Pears.

"I am glad to say that, owing to carrying out your advice of last season, as to using kainite around infested trees, and ruthlessly picking and burning all diseased fruit, the attacks this year have *very much* diminished, and I hope by next season to almost stamp out the pest. I note one remarkable coincidence every year—that 'Louise Bonne of Jersey,' which is our earliest bloomer here, practically escapes altogether, while two of the latest to flower—'Pitmaston Duchess' and 'Williams' Bon Chrétien'—always suffer the most. This would seem to show that the midge can only operate on fruits at the very earliest stage of their existence. I have again noticed the almost entire immunity of trees on walls, no doubt owing to earth around them being kept well hoed, and so always on the move in summer."—(H. H. W.).

"P.S.—I have just had a look over two trees side by side, both of which promise a good crop; on one of them, 'Louise Bonne,' I gathered only two infested fruit, while on its neighbour, 'Pitmaston Duchess,' over fifty diseased Pears were picked. The former tree flowered fully a fortnight earlier than the latter."

On May 16th, 1898, specimens showing attack of this Pear Midge—that is, of *Diplosis pyrivora*—were sent me by Mr. H. F. Getting, from The Gardens, Glewstone, near Ross-on-Wye, Herefordshire, requesting information as to the cause of the small brown or dark velvety-looking spots on the small Pears enclosed.

It will be seen from the following reply to my enquiries which Mr. Getting favoured me with on Jan. 5th, 1900, that it was considered too late in the season to apply the kainite, and lime was tried instead, which appears not to have had any deterrent effect. It is worth notice, in this as well as the preceding note, that "Pitmaston Duchess" is reported as a kind of Pear peculiarly liable to this Midge Maggot attack:—

"I reply to your questions to the best of my ability.

"*Diplosis pyrivora*. When you kindly gave me some advice in 1898 how to deal with this pest, it was too late to apply kainite. Therefore, I thought I would give a heavy dressing of hot lime in the winter, which I did.

"Last spring (1899) the Pear Midge was worse than ever, both as regards further varieties it attacked (among these notably the Duchesse d'Angoulême, which in 1898 was scarcely touched, and in 1899 nearly all were), also as regards number of maggots in a single Pear—in many cases I counted as many as twenty.

"Last year (1899) in good time I applied a heavy dressing of kainite, and shall watch with great interest result on a row of the Pitmaston Duchess, which were about the worst attacked, and at same time finest trees in the plantation. . . . I also heard from other sources that the Pear Midge had been very destructive in some parts of Herefordshire last year."—(H. F. G.)

Early in the year 1898 I received a communication from Messrs. R. & B. Bomford, of Pitchill, near Evesham, desiring information as to measures of prevention, in the (then) coming season, of an attack to very young Pears, which, from the clear account given, was obviously that of this Pear Maggot, *Diplosis pyrivora*; but on May 30th following Mr. Benjamin Bomford again communicated with me from Evesham, with specimens, leaving no doubt as to the nature of the attack:—"I have delayed writing to you respecting the Pears, hoping to have a better report to send from the late blossoms, but I am sorry to say we have a complete failure again this year." The specimens, consisting of five bunches of little Pears, of which the largest were about five-eighths of an inch across, and a little more in length, showed characteristic infestation to a serious extent.

From Mr. Bomford's accounts of the attack of 1899, sent me June 2nd, 1899, and Jan. 8th, 1900, it will be seen that the attack was *much* the worst on the pasture land, and that where the land *was dug*, which would act to some degree similarly to scraping off the maggot-infested surface and destroying it there, was *not a very bad attack*. No marked different effect was observed consequently on application of kainite, nitrate of soda, or of gas lime.

June 2nd, 1899:—"I posted you yesterday two branches of William Pears—the one was the worst I could find, and the other one of the best. On the one I do not think you will find a single sound Pear, but on the other there are about five. The attack is much worse on the pasture land; both these were taken from it; where we have dug the land we have not a very bad attack this season, but unfortunately the Pears have not set well there."—(R. & B. B.)

On Jan. 8th, 1900, Messrs. Bomford further communicated with me:—"In reply to yours of the 2nd. As we stated in ours of June 2nd, the attack of Pear maggots in 1899, although very severe, was nothing like so bad as in 1898, when our entire crop was destroyed. Last year we had about a third of the crop left. We tried, as you suggested,

kainite and nitrate of soda, also gas lime later on in the spring, when the maggots were falling; but we cannot see any marked effect from either, as the attack was uniformly less on all the trees. We will watch them carefully again this season, and let you know if there is any marked effect from either treatment."—(R. & B. B.)

On June 6th, 1898, I was favoured by a communication from Mr. Geo. Brown, Gardens, Bowood Park, Calne, Wilts, relatively to the nature and means of prevention of an attack to young Pears, of which samples were sent accompanying, and by which very many of the Pears were said to be infested. This attack was also of the Pear Gnat Midge, *Diplosis pyrivora*, and showed bad infestation in an advanced stage, the season of the duration of the attack now drawing to a close, and the maggots leaving the destroyed young fruit.

Of about thirty or more Pears sent me (all of which I opened), I found all excepting one were infested. In many cases the attack had been completed, and the maggots gone. In most cases a great part of the inside of the Pear was hollowed out, or decayed, consequently on the attack. The decayed part sometimes reaching across the Pear, and often making a damp, quite soft, decayed condition on part of the side of the Pear through which it was presumable the maggots had made their escape. Some, I found from examination, might very probably have escaped by the communication of the infested decaying and gnawed portion of the inside of the Pear with the opening at the calyx end of the Pear. The maggots appeared to be mostly fully grown, and I counted their numbers up to about six and twenty in two of the Pears which I examined. They were very active, and their skipping powers were very noticeable as they dispersed on the dark red and black tablecloth of my study table.—(E. A. O.; June 7th.)

On Jan. 12th, 1900, Mr. Geo. Brown was good enough, at my request, to place in my hands the following note of the results in 1899 of his careful treatment applied in 1898—namely, of gathering and destroying infested Pears, of skimming off and destroying surface soil around infested trees, and also of dressing heavily with kainite and also with wood-ashes. The result, it will be observed, was that, although the attack again made its appearance, yet "it was not to such an alarming extent as in the previous years."

"The Gardens, Bowood Park, Calne, Wilts, Jan. 12th, 1900:—I have much pleasure in complying with the request contained in your letter of the 8rd inst., and now try to append the information you ask for regarding the infestation of young Pears by *Diplosis pyrivora*. In June, 1898, you were good enough to recommend to me a means of destroying this pest, which I accordingly carried out—

"1st. By gathering and destroying all the infested Pears.

"2nd, By skimming off the surface soil round the trees, and removing it to a distance, where it was deeply buried in a pit; and

"3rd. By dressing the ground heavily with kainite, and also with wood-ashes.

"Last year the gnat again made its appearance, but not to such an alarming extent as in the previous years, and I again adopted the treatment named in the first two paragraphs above; but, lest a second application of kainite might have an injurious effect on the roots of the trees, I withheld that.

"This winter I am trenching the ground under the trees as far as practicable, being careful to have all the surface soil where there may be any of the larva deposited, to a depth of several inches, removed well into the bottom of the trench.

"By following this treatment I hope in time to be successful in exterminating the pest."—(G. B.)

On June 9th, 1898, notes showing presence of severe attack of the Pear Midge maggot on trees where there had been some small amount of infestation in the previous year, were sent me by Mr. F. W. Thomas, from Wannock Gardens, Polegate, Sussex, with specimens accompanying; showing (as in the preceding observation) that at this date the *D. pyrivora* larvæ were leaving the Pears. On June 18th Mr. Thomas further wrote, "I have done as you suggest, and have gathered all the fruit I find affected."

On Jan. 5th, 1900, in reply to my enquiry as to result of treatment, Mr. Thomas favoured me with the following reply, by which it will be seen that he followed up removal of the diseased fruit by application of kainite, and that the result of this treatment in 1898 was that in 1899 he only found six dozen fruits attacked. Mr. Thomas wrote as follows:—

"In reply to yours of the 2nd inst. *re* Pear maggot, I am pleased to tell you I followed your advice and dressed the soil around the Pear trees with a good strong dressing of kainite; this was done in July, 1898. Last year I only found six dozen fruits attacked, which I carefully picked and burnt. It was not at all a good year for Pears in this district, but I noticed that all the fruits attacked were Williams' Bon Chrétien, and Beurré Hardy; Souvenir du Congrès, which are planted in the next rows, quite escaping.

"Thinking to be on the safe side, I again gave a dressing of kainite to those trees which had the fruit attacked in July; I am afraid I gave it too strong to one tree, as I noticed towards the end of the summer the tree looked as if it was going to die, and on examining the roots a short time ago I found all the fibrous portions dead. It is only the earlier kinds of Pears that have ever been attacked in this garden."

On June 16th, 1898, the latest date of observation of attack which was sent me, some samples of little Pears affected by the Pear Gnat Midge were forwarded me by Mr. J. Lansdell, F.R.H.S., from The Gardens, Barkby Hall, near Leicester, with the information that the Pear crop was suffering severely from the pest, and enquiries and observations sent accompanying showed that it was a newly noticed trouble. It will be observed that Mr. Lansdell ascribes the immunity from attack noticed in his reply to my enquiries to be certainly in part attributable to the fact that in 1898 *every* affected fruit which could be seen was carefully gathered and burnt.

On Jan. 6th, 1900, Mr. Lansdell, now Assistant Horticultural Instructor for Worcestershire, replied to my enquiries regarding result of treatment from Pomona, Wyld's Lane, Worcester:—

“With reference to *Diplosis pyrivora* at Barkby during the past year, the attack has been very slight. Unfortunately I did not take note of the exact number of affected fruit, but it would only be about nine or ten.

“I considered the immunity of attack was from two causes. (We had no standard Pear trees.) All were on the walls, or as bushes, so that the trees could be easily watched, and every affected fruit in 1898 (which could be seen) was carefully gathered and burnt. 2nd. In the spring of 1899 we had a splendid show of bloom on all our Pears, but, owing to the severe frosts, the crop was a light one in comparison to the large quantity of blooms, and I considered there might be an enormous loss of eggs of the *Diplosis* in these dead blossoms.”

Summary of the above.—Gathering and destroying infested fruit has had very good results; so has removal of the infested surface, or digging it in; and this stands in contrast to conditions of trees on pasture land (see p. 96), where, of course, the infested surface could not be removed.

Kainite, so strongly recommended in U.S.A. practice, has answered well; and there is a good note of successful use of wood-ashes. No special benefit appears to have followed use of lime or of nitrate of soda. A few notes are also given of kinds of Pears which are considered less or more subject to infestation, with some remarks on what is conjectured to be the reason of this circumstance.

PREVENTION AND REMEDY.—The following are the main points to be attended to, put as shortly as possible. The little maggot-infested Pears, which may be very fairly distinguished by their stunted, lumpy growth, and greater or lesser amount of black spots or patches, should, if possible, be picked from the trees before the maggots leave them to go down into the ground, and should be burnt or otherwise carefully destroyed. On no account merely thrown aside.

If the diseased little fruits can be shaken down, this saves much trouble; but in this case it is desirable that they should be shaken down on to some material spread below, so that Pears and maggots may be gathered up together, and thrown into a deep hole (where they can be safely buried away) or on to a fire. A sticky material is the best for shaking down on, as the maggots have good leaping powers, and, unless prevented, may get away.

Where the trees are not growing in grass, and the ground beneath them is free of crop, and also the Pear roots not too near the surface, the plan of skimming the surface, and destroying the surface earth with its contained infestation, would answer well. The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed. Any time would be suitable for this operation between the time of the falling of the infested Pears from the trees, and such a date in the following winter or spring as would ensure that the cocoons should be skimmed off and destroyed in the infested earth before the season came (or rather, drew nigh) for the appearance of the Gnat Midges, which takes place with that of the Pear blossoms.

Where digging is admissible, this, if properly carried out, is serviceable (see p. 98); but if the operation only consists in breaking up the surface, as in the common method of digging, it is not likely to do much good. The infested earth should (as noted) be carefully buried away.

The best application to use for dressing appears, both from the published experiments of Prof. J. B. Smith (see note, p. 94), and also from our own trials, to be kainite. With regard to amount given in an experiment on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown, fifty per cent. were "midged," and of the other kind named not one could be found to have escaped.

But in the case of sprinkling with a small quantity of kainite, in laboratory experiment, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in the jar had ever formed cocoons, and those that did seemed all of them to be dead."

Also, in laboratory experiment, Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone

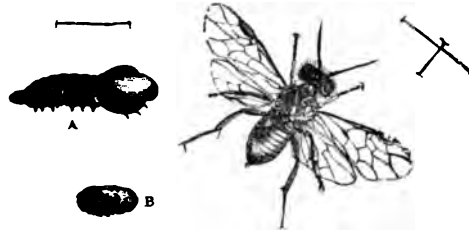
down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of nitrate was applied, a still lesser proportion of the maggots were found to be alive.

Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

I am not aware of the action of lime having been tried, but the experiments are given in minute detail in the Bulletin referred to at p. 94.

In our own (preceding) horticultural reports of experiments, it will be noticed that various kinds of Pears are named as subject or not subject to attack, which may prove to be serviceable information; and I offer my best thanks to my contributors for their kind courtesy in allowing me to give my readers the benefit of their skilled practical observations.

Pear and Cherry Sawfly. *Selandria atra*, Stephens and Westwood;
Eriocampa limacina, Cameron; *Eriocampoides limacina*, Retzius.



SELANDRIA ATRA.—A, "Slugworm" of Sawfly; B, cocoon—both much magnified; Sawfly, with lines showing natural size.

The infestation of the Pear and Cherry Sawfly, figured above, has been known for more than a hundred and fifty years as injurious to leafage of various kinds, and especially to that of Pear, Cherry, and some other kind of fruit trees by means of its small, slimy, Slug-like, blackish, or bottle-green caterpillars feeding on the upper sides of the leaves until, in cases of severe attack, nothing is left but a network of veins held together by the skin of the under surface of the leaf.

In some years, as in 1896, the infestation has been widespread, and caused a great deal of damage; but, so far as reported, it never reaches the height, in this country, of being one of our great fruit pests, and with moderate care (since its life-history has been known) it can be kept well in check. In the United States the attack is much more injurious, both by the virulence of the attack itself, and also by the abundance frequently occurring of presence of the second brood. The identical nature of the American with the European infestation has

been proved by careful examination of specimens. This identification is of some importance, for the most serviceable account, both practically and scientifically considered, which has been recently published is, I believe, that of Mr. C. L. Marlatt, First Assistant Entomologist to the U.S.A. Department of Agriculture.*

All who have studied the subject will be aware of the difficulties arising from multiplicity of scientific names of the insect, and Mr. Marlatt, in his paper referred to below, mentions that in Europe this insect has received at least *nine different specific names*, and has been referred to some *eight genera*. In the two appellations given at my own heading, I have followed the guidance of our European writer, Prof. Westwood, and also given the more recent appellation especially selected by Mr. P. Cameron †; in Mr. Marlatt's paper he gives the attack as that of *Eriocampoides limacina* of Retzius, one of the earliest observers (in 1788) of the infestation, which I have therefore added.

The stage of attack at which the presence of the mischief is usually first noticed with us is during the early part of the summer—as, for instance, about the middle of June—when the little Slug-like grubs may be found feeding, though usually not more in number than three or four, on the upper skin (*epidermis*) of the leaf. This they sometimes clear wholly away, leaving only the network of veins beneath it, and the skin of the lower side of the leaf, which consequently turns brown and dies; and in cases of bad attack, the condition of the growing fruit and the health of the tree are necessarily injured by the loss of leafage. Often, however, the upper surface is only eaten off in patches, but still enough damage caused to draw attention to the presence of the leaf enemy.

The larvæ, or Slugworms, are for most of their lives of the shape figured at A, p. 101, about three-eighths of an inch in length when full grown, somewhat broader and thicker at the fore part of the body, and covered with a blackish or greenish slimy exudation, giving the Slug-like appearance from which the larva takes its popular name.

After feeding for five or six weeks they moult off their slimy coats, and appear as ordinarily shaped caterpillars, buff or yellowish in colour, dry (that is, no longer covered with a coat of slime), and transversely wrinkled. In this condition the *twenty-two* pairs of feet (that is, three pairs of claw-feet, and a pair of sucker-feet on each of the other segments excepting the fourth) are much more easily distinguishable than when they are in Slugworm state, though the pair at the end of

* See "The Pear Slug, *Eriocampoides limacina*, Retzius": Circular No. 26, Second Series, United States Department of Agriculture, Division of Entomology, p. 7. Washington, 1897.

† 'British Phytophagous Hymenoptera,' by P. Cameron, vol. i. p. 224. Ray Society.

the tail is so small that sometimes it has been passed over, and the larva classed as *twenty-footed*.

After the final moult to the yellow-coloured non-slimy state, the caterpillars leave the food-plant, and bury themselves a little below the surface of the ground, where they spin a somewhat cylindrical obtuse-ended cocoon (see fig. 8, magnified, p. 101); this is only about one-quarter of an inch in length, and, from the adherence of the surrounding particles of earth to the silky web cocoon spun round itself by the larva, is very difficult to distinguish from the ground in which it lies. Under common circumstances, the cocoons, as far as I am aware, are made singly in the earth, and at a distance of about from half an inch to two or three inches beneath the surface, but, as mentioned by Mr. Cameron, when the larvæ are very numerous, the cocoons are spun close to each other; and in the course of last summer, in a case in which the conditions of ground did not fully allow of the usual arrangements, some such interesting observations of some of the cocoons being sheltered amongst large Pear roots, and some being formed into clusters composed of several scores, were made by Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, and kindly placed in my hands, that I have pleasure in inserting his notes with three of his series of illustrative photographs (see pp. 105, 106).

Within the cocoons the caterpillars change to the chrysalis state, from which, although some of the Sawflies may develop in the same season, the main brood (in this country) does not make its appearance until the following year; the exact rate of development, and the extent to which the infestation may be double-brooded here, appears to be variable, or at least not matter of certain record.

The Sawflies (see figure, with lines giving natural length, at p. 101) are rather less than a quarter of an inch in length, black, shiny, and rather downy, or pilose, with the horns (antennæ) rather longer than the fore body (thorax); legs black or fuscous, or with the shanks of the anterior and middle legs respectively testaceous and fuscous; from differences of description, the colouring of the legs appears to be variable. The four wings transparent and iridescent, with a smoky band across the middle.

The above are the stages of the infestation most commonly observed, those connected with the egg deposit, which starts the attack, being on such a minute scale as to require a magnifying glass to distinguish the details.

The places of egg locality, as I have occasionally seen them myself,* are to be found in the upper side of the leaf as little spots roundish in

* See 'Observations of Injurious Insects,' by E. A. Ormerod, during 1893, p. 81.

shape and whitish in colour (from the upper coat of skin being dead), slightly raised in the middle, and of a somewhat transparent tint *just over the contained egg*, which was a soft mass, compressible, thick, and somewhat circular in outline. These little white blisters, or patches, of white dead skin *covering the eggs*, were about one-sixteenth of an inch across, and on one leaf where I counted them, over thirty in number, on another there were about twenty-five; all these (with possibly one exception) showing on the upper surface of the leaf.—(E. A. O.)

The process of egg-laying, which I had not the opportunity of observing, is thus described by Mr. C. L. Marlatt in his paper on habits of the "Pear Slug," referred to in note at p. 102, *ante*:—"But one egg is deposited in a place, and it is always inserted from the under side of the leaf. The ovipositor is thrust obliquely through the leaf to the upper epidermis, but not piercing the latter, and shows there distinctly through the transparent upper skin of the leaf." [The description is accompanied by a figure.—E. A. O.] "The saw-like instrument, when brought into the position noted, is moved rapidly with a swinging lateral motion from side to side, cutting the upper epidermis free, so as to form an irregular cell or pocket of peculiar flattened ovoid outline. The egg is quickly passed down between the plates of the ovipositor, and dropped into the pocket thus made, the time occupied being a little over one minute for the entire operation. . . . The egg is oval, slightly flattened on one side, and remains in its peculiar cell for a period of about two weeks before the larva escapes."—(C. L. MARLATT: see paper previously referred to.)

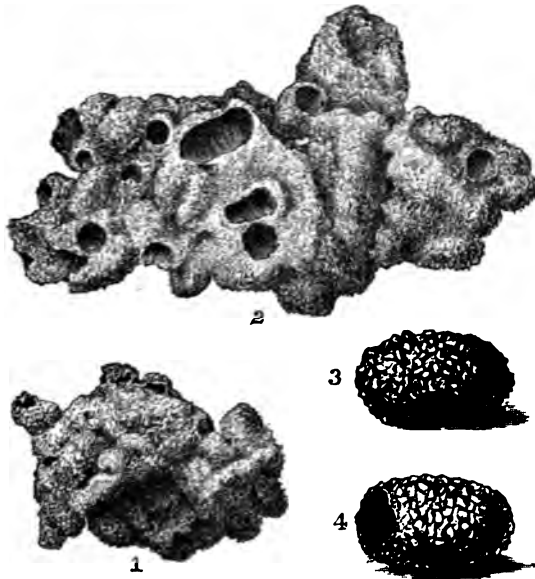
Mr. Newstead's description of the egg in his paper, from which I quote at length further on, agrees very nearly with the above:—"Form subcircular, slightly flattened, shining. . . . It is laid on the upper surface of the leaf beneath the epidermal layer."—(R. N.)

In my own observations, taken from specimens sent me on June 14th, 1898, I had the opportunity of seeing the Sawfly larva whilst still in the egg. Most of the larvæ had hatched out, leaving only the white skin cracked where the maggot had effected its escape, but two eggs still remained unhatched. One of these eggs contained the white Sawfly larva curled on itself within, and sufficiently developed to be of characteristic shape—that is, with the largest segments behind the head, and the hinder portion of the maggots with the segments much narrower transversely. In the other egg the contents were not yet sufficiently developed to be defined in shape. I did not see any larvæ in the act of coming out of the egg, but the smallest of them were as a general thing of a yellow colour.—(E. A. O.)

As recorded by Mr. Marlatt, the larva at first is clear or free from slime, and in colour nearly white, except the yellowish-brown head,

but almost immediately the slimy exudation begins to form and spread over its whole body, giving the Slug-like appearance from which it takes its name.

The above notes give, in condensed form, the most noticeable points of the habits and method of attack of the Pear Sawfly. The amount of injury and the appearance of the injured leafage (see p. 102) has been so often described that it is unnecessary to notice it again, and the very important point of the capacity of the *larva* or Slugworm for throwing off its slimy coat, and thus getting rid of acrid or irritating dressings which may have been thrown on it, is entered on under the heading of "Methods of Prevention and Remedy" (p. 110).



1, Cluster of about one hundred cocoons, natural size; 2, part of cluster in which the larvæ have bored into the mortar to form their cocoons; 3 and 4, cocoons, much magnified.

Previously to this, however, I give the following notes regarding attack of this infestation to a Pear tree, first observed about five years ago by Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester, which he kindly permits me to make use of, and which I insert *in extenso*, as they enter on many points of much interest to treat of together, and especially as giving instances of the caterpillars under special circumstances, in some instances forming their cocoons on large roots of the Pear; and also, in other instances (from lack of room), placing their cocoons so closely together as to form connected clusters of several scores. The figures above are copied, by permission, from photos taken by Mr. Newstead.

The detailed description of the attack was given me by Mr. Newstead writing, on August 31st, as follows :—"Just five years ago I was asked to inspect a blighted Pear-tree, in the immediate neighbourhood of Chester, which I found to be infested with Slugworms or larvæ of *Selandria atra*. The attack was a moderately bad one, but the tree had not then suffered to any serious extent from the effects of the infestation.

"Since then year by year the insect has increased until now, with the aid of a hot summer, the upper half of the tree has been denuded of its leaves, the result of the work of these black pernicious pests, which have shorn almost every leaf of its upper epidermal layer, making bare the delicate nervures, and causing the leaves to prematurely fall from the tree.

"My advice was to apply a dressing of Paris-green (in proportion one ounce to twenty gallons of water); and in the winter to clear away all surface soil and destroy it. The Paris-green was applied, but to a part of the tree only, and it appeared to have 'little or no effect' (so my informant states) upon the larva. To have ensured success the application should undoubtedly have been given to the whole of the tree, and I now think the quantity of Paris-green might with safety have been doubled.

"There was a difficulty in removing the surface soil, as, with the exception of one square foot at the base of the tree, the whole of the root-area was covered with small paving-stones (water-worn boulders or 'cobbles'), forming part of the stable-yard.

"To remove the surface soil meant also the removal of the stone pavements, which would have entailed great labour, and so the most effectual method of prevention was not carried out. But as a substitute a top dressing of *hot lime* was applied, which, *judging from* the abundance of the pest this year, appeared to have little or no effect upon the larvæ as they descended to spin their cocoons and pupate, or upon the well-protected pupæ in the soil.

"This year (1899) two applications of 'paraffin emulsion' were made, but without the slightest effect upon the 'Slugworms,' and in despair the tree was condemned to the axe, with a view to *planting another in its place*. Before doing so, my gardener friend sought my advice, and I paid a second visit to the infested tree. The upper half had scarcely any leaves upon it; and almost all the leaves that remained were brown and threadbare from the ravages of the pest.

"The greater number of larvæ had gone down to spin their cocoons and pupate, but there still remained a few larvæ *in all* stages, from the newly hatched embryo to the full-fed individual ready to cast its shiny Slug-like coat, and to descend to the earth, there to pass its long winter sleep.

"I felt it was useless applying insecticides to the few remaining larvæ, and that my only course was to *demonstrate* to my applicant the absolute necessity for clearing away the surface soil. I had on no previous occasion dug out the cocoons of this pest, and therefore was not at all certain of the most favourable spot to search for them; but a former experience with the cocoons of the Gooseberry Sawfly (*Nematus ribesii*) enabled me to form an idea as to its nature and the difficulties of finding so comparatively small an object, which exactly resembled a crumb of earth.

"My attention was directed to an examination of the soil between the roots at the base of the tree; this was carefully rubbed between the palms of the hands as being the surest way of finding the loose cocoons in the earth, but none were found in it.

"Noticing patches of apparently loose earth still attached to the bark of the roots, these were carefully removed, and beneath them were found several cocoons *attached to the bark*. Numbers of others were *clustered together* at the bifurcations of the roots; and further away others were more isolated. Nothing could be more interesting than the wonderful way the cocoons resembled the colour and irregularities of the bark, and when fixed in a crevice it was impossible to detect them without probing and rupturing the cocoon. Portions of the bark bearing the cocoons were removed and photographed (fig. 1, p. 105).

"My attention was next directed to the crevice (about an inch wide) between the stone pavement and the wall; three of the stones were removed and the *soil adhering to the wall* carefully examined. To my astonishment I found this a compact mass of cocoons, some of them old and empty, others containing the newly imprisoned larvæ, changed in form to a short almost cylindrical-shaped insect of a pale yellow colour, and apparently quite inert. The gardener, who had watched my proceedings, was simply astounded at the discovery, and could scarcely believe they were the recent enemies of his ill-fated Pear-tree.

"I continued my search along the wall, exposing in all about twelve linear inches, and from so small an area (say eighteen cubic inches) I got about eight hundred cocoons. They were all cemented together in masses, and so firmly attached to the wall that I successfully cut away portions of the brickwork with the cocoons still attached (fig. 2). None of the cocoons occurred at a greater depth than one and a half inches, while those near the surface were barely covered. While removing the cocoons several specimens of the perfect insect were liberated; they were very active, and ran about the soil seeking a hiding-place, and making every effort to escape, but, strange to say, did not attempt to use their wings; the sun had gone down, and this may account for their reluctance in taking flight.

"This discovery set me wondering whether these insects would have hibernated in the soil through the winter, or whether they would have escaped on the morrow to lay another batch of eggs upon the tree.

"Early on the morning of the following day (Aug. 22nd) I paid a second visit to the infested tree in the hopes of clearing up this interesting question. It was just ten o'clock, and the sun fully ablaze upon the tree, and the Slugworms reflecting the rays of light, like beads of highly polished jet or glass. There, almost immediately in front of me, on a young tender leaf, sat a female Sawfly, evidently enjoying the hot sun. I believe now she was in the act of laying an egg, but in my anxiety to procure the specimen I did not wait to see, but immediately 'boxed' it. Not another specimen was to be seen, and no wonder, as all the cocoons had been removed and destroyed. Miss Ormerod's description of the egg* enabled me to find a number of them, especially on the younger leaves, and sitting alongside of one of them was a newly hatched larva ('Slugworm'), and one of them which I subsequently dissected (see description of egg) appeared to have been recently laid.

"By the foregoing observations we have established the following important facts:—

- A. The existence of the insects in all stages in August.
- B. The exact position of the cocoons in the earth.
- C. The effects [or rather the non-effects] of a top-dressing of hot lime.
- D. The apparent uselessness of an application of paraffin emulsion.
- E. The result of a *partial* application of Paris-green.

"It may be well to discuss these points under their different headings.

"By the existence of the perfect insect in August we may safely infer the species is at least double-brooded. My friend here says there are two distinct broods of the 'Slugworms'; the first appearing in late May and early June, the second in August. In support of this, Miss Ormerod (Annual Report for 1893, p. 82), quoting the observations of Mr. Cornford, of Etchowe, Lansdown Road, Cheltenham, says, 'the second brood is now *en évidence* about six weeks after the first,' which Miss Ormerod (*loc. cit.*) thought 'attributable to irregular date of pupation.' Writing later (Aug. 18th) Mr. Cornford said of the larvæ, 'they are still appearing on the trees, from the smallest to the full-grown size.' Thus the evidence of the two observers practically agrees, and it is just possible that the first brood of larvæ produce perfect insects in August, and will account for the specimens I have obtained here.

* See 'Report of Observations of Injurious Insects for 1893,' p. 81; also *ante* p. 104.

"Judging, however, from the occurrence of the eggs, larvæ in all stages, pupæ, and perfect insects at one and the same time, I am inclined to think that, like the Gooseberry Sawfly (*Nematus ribesii*)—in favourable seasons at least—there is a succession of broods from May till October.

"The exact position of the cocoons in the earth is of importance as giving us the amount of surface soil to remove, and also the particular places to which we should direct special attention—*viz.* the wall below the surface of the soil, and the bark of the larger roots at the base of the tree (*see* 'Methods of Prevention,' below).

"The application of hot lime as a top-dressing certainly appears to have had no effect upon the pest. It was applied about twelve months ago, and now forms a thin hard layer between the stones; one would think it sufficiently hard in places to prevent the larvæ now getting through it, or the *imagines* finding their way through it after escaping from the cocoons; but one fragment of the lime which I successfully removed has a boring completely through it, as well as through a layer of cloth (an old 'shred' with nail attached) which had fallen into the lime while in a plastic state.

"I can offer no comment upon the application of paraffin emulsion, only that my friend fully assured me that it had not the slightest effect upon the Slugworms. I fully believe, however, that, had the application of Paris-green been applied to the whole of the tree, and the strength doubled, it would have had the desired effect.

"*Methods of Prevention.*—Remove surface soil three to four inches deep all along the wall beneath the infested tree, to a little distance beyond the longest branches, and to about eighteen inches distant from the wall; also expose all the larger roots at base of tree. Scrape and carefully remove all adherent soil, &c., from the wall and the roots and root-forks. A trowel or 'hard chisel' is suitable for scraping the wall, and a blunt piece of wood suitably shaped should be used for scraping the bark of the *largest* roots. The scrapings should not be allowed to fall to the ground, but collected as they fall, and all should be destroyed by fire; on no account should they be thrown to the rubbish-heap. To ensure success, paint the *wall* with pure paraffin, and the roots with a soap-wash applied with a stiff brush. Give a top-dressing of suitable soil to replace the surface soil removed. The above rule applies similarly to the surface soil; this also should be subjected to the action of fire, or buried in a deep hole, in order that the pupæ may be destroyed."—(R. N.)

I have given the above notes *in extenso*, as Pear trees against walls are so liable to be attacked by the so-called "Slugworm" that the minute details of what may be happening in many instances is of interest practically, and several of the points are well worth record.

The observation of the larva being able to work its way through material of such very different nature as mortar and cloth-shred is of interest. The circumstance of kerosine emulsion failing in effect was, I conjecture, attributable to the power possessed by the "Slugworm" of moulting off its protective coat of slime (together with the irritating dressing). For this reason it is necessary to watch the effects of any remedial application, and in case it is moulted off it should be renewed as soon as possible. If much time is allowed to elapse between the dressings, the larvæ will have regained their power to produce the slimy condition, and in all probability the second application of dressing (wet or dry) will be moulted off like the first.

Strong soapsuds, well syringed at the infested leaves, have long been found a useful application with us.

In Mr. Marlatt's 'Bulletin,' referred to previously (page 102), he mentions a simple soap solution or an arsenical wash, sprayed on the plants, as the best means of destroying the larvæ. The soap-wash (it is mentioned), "to be effective, must be applied at a strength of one-half pound of soap to a gallon of water, first dissolving the soap, preferably whale oil, by boiling in a small quantity of water." "The plants may be sprayed with Paris-green or other arsenical wash at the rate of one pound of the poison, mixed with an equal amount of lime, to two hundred and fifty gallons of water."—(C. L. M.)

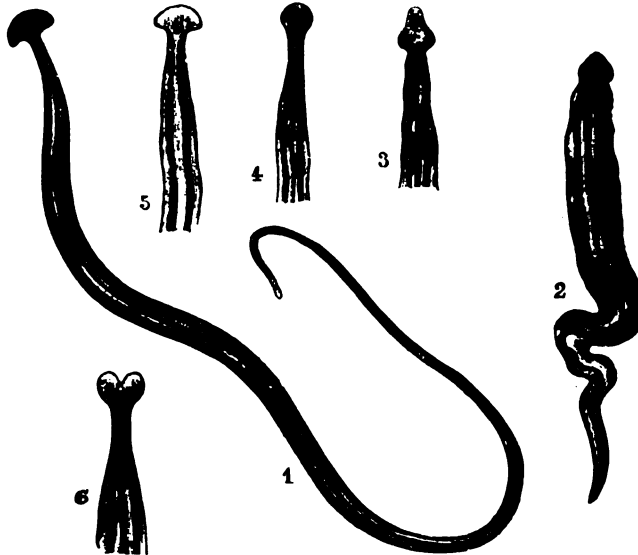
The amount of the Sawflies themselves which are present on the leafage may be lessened by jarring or shaking the infested boughs; but, when fallen down, though they may remain for some time motionless, they will subsequently cease feigning to be dead, and fly away, so that it is desirable to beat them down on to boards, or anything that is convenient to use, which has been tarred on the surface, and thus destroy the flies before they escape.

One of the simplest and at the same time most thoroughly successful applications that I am personally acquainted with is, dusting the Slugworm-infested leafage with a mixture of soot and lime. I have found this to answer perfectly in my own garden in killing the grubs, without any repetition of the treatment being needed; only, if the weather is dry, it is well to give the leaves a good syringing over in a day or two, to clear them from the powder.

Skimming, or removing the surface of the infested ground to the depth at which the cocoons lie, and removing and burning or deeply burying earth and grubs together, is an obvious method of preventing much recurrence of attack; and with a very moderate amount of care this kind of infestation lies so much under the power of *remedial* as well as *preventive* treatment, that in this country at least it need not cause much injury.

PLANARIAN.

Land Planarian ; "Flatworm." *Bipalium kewense*.



BIPALIUM KEWENSE.—1, extended ; 2, contracted ; 3, 4, and 5, different forms taken by the head, all life size ; 6, bifid form of head, rather larger than life.*

The worm-like creature, with its various forms of head, figured above, scientifically known as a "Ground Planarian," is not noticed on account of any injury which it causes, of which I have no notes, nor do I find mention of it causing, in such publications as I am acquainted with as to its history. But, as among the rare notices of observation of this "exotic worm" in this country, it is mentioned as found in a greenhouse, in hothouses, also amongst broken tiles at the bottom of a pot of *Calceolaria* which had been in a cold frame all winter, and also amongst broken flower-pots, it seemed to me that a few notes on the subject might be acceptable to some who may be as unacquainted with this repulsive almost poisonous-looking "Flatworm" as I was myself, on as specimen being sent me for examination in May of the past season.

* The above figures 1-5 are from the plate accompanying the "Note of *Bipalium kewense*, and the generic characters of Land Planarians," by Prof. F. Jeffrey Bell, M.A., Sec.R.M.S., in 'Proceedings' of the Zoological Society of London, 1886, pt. ii. pp. 166-168. Figures 1-5 are copied, excepting in respect of the position of figure 1 being altered to adapt it to space. Figure 6 is from my own specimen, somewhat enlarged.

It was on May 20th (1899) that I received a note from one of our leading horticultural firms asking information regarding the specimen sent accompanying, which had been forwarded to them by a correspondent from an English locality. On examining the moss sent, I saw nothing present excepting a kind of slimy-looking streak, of the nature of which I knew nothing; but, conjecturing from the locality named (a hothouse or some similar locality) that moisture and slight warmth might help to show something more plainly, I placed the moss in some very slightly warmed water, and the effect was rapid.

The slimy streak became evidently alive, and gathered itself together into the shape of what seemed to me something like a Leech, or still more like a small Snake with a bifid head, but much shorter than "1" of the figure at p. 111, and narrower than "2" of the same figure.

The colouring was of a kind of livid grey, with three darker longitudinal stripes starting from behind the head, as especially shown at figures "1" and "6." The head itself was of the bifid shape in front figured at "6"; and during the time that I watched the worm, so to call it, I did not observe any alteration in the form of the head, which alterations were, I believe, first recorded by Prof. Jeffrey Bell as one of the remarkable characteristics of this species. This time of observation, however, was very short, for on feeling the warm water the "Planarian" set out very soon on its journey for more comfortable quarters, and travelled up the sloping sides of the bowl, carrying what I then saw to be its bifid extremity (and subsequently found was its head) steadily before it, and by the help of its flattened under surface it made such solid although slow progress that, as I was at the time quite unaware what might be the habits of the repulsive-looking animal, I thought that the sooner it was shut safely up again the better.

I therefore replaced it with its lump of moss in its box, and returned it to my correspondents, with the suggestion that they should ask the favour of identification from the British Museum authorities at South Kensington.

This they accordingly did, and on May 24th informed me that the specimen had been identified for them as the *Bipalium kewense*. Consequently the animal proved to belong to the *Geoplanidæ*, or "Land Planarians," a division of the *Planariadæ*, which are one of the vast numbers of families into which the great class of *Vermes* is divided. So that for the sake of a generally intelligible appellation, although these "Ground Planarians" differ in important respects from the *Annelidæ*, which include our common Earthworms, they may correctly, as well as conveniently, be described as "worms."

The description of the *Planariadæ* is that the body is of a long

oval, flattened shape, often provided with lobed processes, more rarely with tentacles, and, as a rule, with two eyes, which are provided with lenses. The subordinate division of the *Geoplanidae*, or Land Planarians, is characterised by their *elongated and flattened body, which is provided with a foot-like ventral surface.**

The fullest observations on *B. kewense*, of which I have knowledge, are those by Prof. F. Jeffrey Bell, given in the 'Proceedings' of the Zoological Society, referred to in note, *ante*, p. 111. In this, Prof. Bell particularly directs attention to the variability of the form of the head, so that, whilst the "cheese-cutter," or hammer-shaped head (see figures 1 and 5, p. 111), are very commonly known forms, there may be other shapes, as knob-like, tongue-like, or altogether irregular. Of these and other forms Prof. Bell gives a series of figures (drawn from life under his own superintendence) in the plate accompanying his paper, above referred to, and from these (with acknowledgment of my indebtedness for the assistance) I have given copies in my own figure at heading, p. 111, 1-5. It appears to me of exceeding interest that not only should there be a difference in form of the head under different conditions, but that, as personally observed by Prof. Bell, the head of a single specimen should vary considerably and almost constantly in form, and it is from the changes of one specimen that the figures given are represented.

In the case of the bilobed or emarginate head of the specimen under my own observation, I did not notice what the form might be until it was progressing up the side of the bowl, where I had a good view of it against the white china. My figure is given rather larger than life.

Very little information bearing on ordinary points of life-history appears to be accessible. The creature is recorded as having lived in the Kew hothouses for a period which, at the time of writing, extended over eight years; also its great power of secreting slime, so that minute objects causing annoyance could be thrown off "in a continuous sheet of mucus," is noted. I do not find any account, whether in the general habits of the great divisions of *Vermes*, to which the *Planariade* belong (or in more special accounts), of these Flatworms being injurious to plant life; possibly this short notice may induce such of my contributors who may be acquainted with them to add some information. But to those who are unacquainted with the repulsive looking creatures, which yet may be come on unexpectedly in earth at the bottom of pots, amongst broken flower-pots, or other horticultural localities, a short notice of the Flatworms, and reference to what, so far as I know, is our fullest British account, may not be unwelcome.

* See 'Elementary Text-book of Zoology,' by Dr. C. Claus, vol. i. pp. 315, &c.; translated by Prof. Adam Sedgwick. 1889.

POPLAR.

Puss Moth. *Dicranura vinula*, Linn.; *Cerura vinula*, Steph. Cat.



DICRANURA VINULA.—Moth (male), and caterpillar (life-size).

The caterpillars of the Puss Moth live on the leaves of Poplar, Willow, and Sallow, and, though not uncommon, do not appear to cause a serious amount of injury, excepting when the attack occurs to trees which are still so young that the loss of the leafage makes an important difference to their growth, or when, as in nursery plantations, they are so very young that the gnawing of the caterpillars at the bark a little above ground-level (in order to furnish themselves with suitable material for their cocoons before turning to chrysalis state) results in such injury to the weak stems that these break off, or the young plant dies from the stem being “ringed.”

When full-grown (and extended) the caterpillar is more than two and a half inches in length (without the tail appendages), but its more favourite position is somewhat as figured, with the body resting on the sucker-feet, the fore part raised, and the head drawn back squarely into it, and, in case of the larva being alarmed or irritated, a long crimson silk-like thread is protruded from each of the rough horn-like processes appended to the tail segment.

Notwithstanding its great size, the caterpillar is not very conspicuous, by reason of the greater part of its colouring (excepting in its early life) being of some shade, or shades, of green, much resembling

the tint of the leaves on which it feeds. The colours along the back are of a kind of purplish brown, streaked lengthwise with white lines, above the white band (shown in the figure), which it will be seen rises in a point towards the fore part of the body, and runs down in a well-defined angle above the second pair of sucker-feet, sometimes, as shown at p. 114, for only a little way down, and sometimes reaching a considerable way down the side of the caterpillar, with a variety in the accompanying markings, as shown at p. 118. When the head is withdrawn into the following segment it appears as if placed in a squarish pink border, with two black or dark spots, somewhat at the sides.

The life-history is that the eggs are laid singly, or almost singly, near together on the leaves of the trees selected. The earliest date of egg-laying that I find recorded is May 25th, and the eggs* are described as "button-shaped, convex above, nearly flat underneath, fairly round, with a small pit at the apex"; the size from above half a line to nearly a line at the widest diameter, and the height slightly more than half a line; the shell hard, glossy and pitted all over; the colour rich warm brown above, more smoky beneath, the central pit blackish, but ringed with yellowish white. A pale variety of the egg is noted as being chiefly of a buff tint.

The larvæ hatch, as recorded under observation, in a period of from ten to fourteen days, and in their early conditions are so different in appearance from their later development that they are scarcely recognizable as of the same kind. In the past season I was able to make some personal observations on these points, which I give at pp. 116-118, but—continuing the life-history generally—the caterpillars feed until in July, or even in August, they are full grown, and then go down the trees to form their cocoons on the bark not far from the ground. The method commonly followed appears to be to gnaw a piece out of the bark, and in the hollow thus made to spin a tough cocoon, in which the larva turns to the chrysalis state and so remains during the winter, the moths for the most part appearing in the following May.

The caterpillars, however, do not appear to be very particular as to the material of which they make use to strengthen their gluey cocoons; a specimen under my own observation used a small piece of carpet, and thus with the floor of its box made a very solid shelter; another (received last summer) worked up some white cotton wool in which it had been sent, for the purpose; and an instance is given by Mr. Hellins (see Mr. Buckler's 'Larvæ,' quoted previously) of his taking

* For description of eggs, and detailed observations of larval and pupal conditions, see 'Larvæ of British Butterflies and Moths,' by the late Wm. Buckler. Ray Soc., vol. ii. pp. 143-150.

a cocoon from a stone wall near a Poplar tree and finding the cocoon coated all over with little bits of the red coarse sandstone of the wall.

But the instinct of the caterpillars leading them to gnaw their cocoon material from the bark of their food-trees is one of their especial ways of occasionally doing great harm. In the year 1890, an example of this was reported to me in which the little trees were so young and small that the amount of woody material and bark removed by the caterpillar weakened the young Poplar plant to such a degree that the stem broke off. In the specimen sent me, the slender stem was completely bared of bark for some little distance from the hard cocoon, and the young plantation was reported to be *practically destroyed*.

The moths, which may be expected to be on the wing in May, are marked as shown in the figure of the male, p. 114, and are very fine insects; the male about or upwards two inches and a half in spread of its fore wings; those of the female still larger, even as much as three inches and a quarter in expanse. The fore wings are white and grey with darker and black markings; the hind wings white at the base but smoke coloured in the disk; the head white, and the body between the wings whitish with black spots; abdomen whitish grey with transverse darker bands. From their soft furry appearance the name of Puss Moth has been bestowed on them.

The above notes give a general description of the history and habits of the infestation in its various stages, and of the colouring of the caterpillar from the time that it is somewhat more than half grown onwards. But in its early life the colouring is so different that it is not always recognized as being the same species of larva, and on June 26th in the past season a young specimen was sent me from a contributor who had found it feeding on a Willow tree (with enquiries accompanying as to its nature), which gave me the opportunity of watching the change of colour through all but the quite early condition.

When hatched from the egg the caterpillar is described as "a queer little creature," with warts projecting over the head like horns; of an intense sooty black above and black with claret tinge below.

My specimen had advanced beyond the quite earliest condition, but the upper part (which in mature state is of a purplish colour, streaked longitudinally with white lines) was still jet black, and the lower part of the body of a clear yellow. Behind the head on the next segment were a pair of lumpy black processes of a somewhat horn-like shape, placed on each side. These, when seen with a moderate magnifying power, appeared to have several reddish spots at the extremity. The larva fed fairly well on Poplar, and on June 29th had grown to approximately a length of half an inch. The colouring was now of brown tint with minute mottling of darker

brown above, and green below; the black tubercles behind the head were covered with sharp spiny processes, and (together with these) were of a somewhat spherical shape, widening below into the first segment behind the head, of which they formed part. The caudal horns were spiny, of a somewhat yellowish and varied brown at the lower part, and nearer the extremity with two dark brown bands separated by a pale one; the tips were of a purplish pink.

The caterpillar fed heartily on fresh Poplar leaves, and continued growing; on the 80th a streak of darkish colour was noticeable running down the side from the lowest angle of the dark colour on the back, and by July 2nd the tubercles behind the head appeared of a more triangular shape, beset with upright prickles, but altogether lessening rather than increasing in size compared with that of the grub.

In the afternoon of the same day about 1.45 p.m. I noticed that the caterpillar had moulted, the tails showing distinctly in the cast-off skin. The processes behind the head now appeared as little more than prolongations of the raised band between them, with some rather blunt prickles at the tip and to some degree around them. The moulted off skin of the eyes and mouth were lying apart from the rest.

July 10th. About two days previously to this date the caterpillar began to spin a slight amount of web on the leaf surface, and exuded a large drop of transparent green fluid; the larva remained stationary at one spot, and apparently was firmly fixed by the sucker-feet in its web, for I was unable to detach it. On the morning of the 10th about 8 a.m. I found the caterpillar had again moulted its skin, including the caudal tails and the prickly tubercles from behind the head.* The colour had become lighter above, and the central raised point above the third segment was now partly of a dull pinkish colour. The localities where the spiny tubercles (now moulted off) had been were smooth, and there was now a pinkish line of about the length of half the space between them just above the head. About 10 a.m. the larva had turned round, and appeared to be devouring the shed skin. The tails or caudal appendages were now, excepting towards the base, white, with rings, prickles, or slight knobs of black.

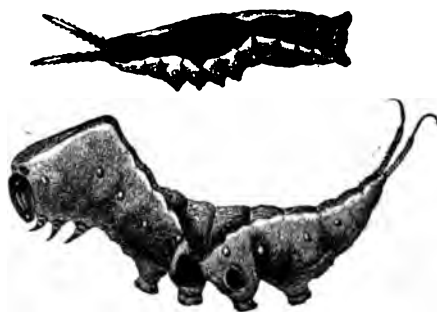
July 11th. The caterpillar was feeding heartily again, and growing fast, and had now a pink line all round the face, with pale yellowish or whitish border outside (at the sides), and treacle-coloured or pitchy spot on each side above the face, taking the place of the spiny tubercles.

July 14th. The caterpillar was feeding greedily, and was now grown to what was presumably its full size, being somewhat more

* In the account by Mr. Hellins, in 'Buckler's Larvæ of British Butterflies and Moths,' referred to, p. 115, of his observations of the changes of the larva of the Puss Moth, he mentions that he has not details of the fourth moult, but that at the fifth "the horns are gone and their places marked by dark velvet spots!"

than two and a quarter inches in length from head to base of the horn-like tail processes. The colours had developed well, and, without entering too tediously on details, might be said to show the customary characteristics. The back was mostly of a purplish brown, darker at the edges, and varied with minute white dots and longitudinal streaks. The segment behind the head for the most part greenish in a transverse band in the fore part (excepting the pinky colour above the face, and dark patches at corners above the face), and the centre of the next segments palish with somewhat greenish tint. The face itself brownish.

My specimen proved to be one of the varieties possessing a dark patch on the side, placed just below the lengthened angle of the dark



Larva of Puss Moth before last moult; also full grown, showing side mark.*

dorsal stripe, and known together with it as the stirrup and saddle flap. Mr. Hellins records "six good variations" in form of the flap and stirrup, and that on my specimen must have been one of the most marked mentioned, and there was also a dark spot on the side of the next segment just above the sucker-foot. The abdomen was green, deepest in tint at the lowest part of the sides, with two long dark stripes running beneath from the fourth sucker-foot to the tail.

The above details do not perhaps bear much on practical economic considerations, still they may be of service in drawing attention to the infestation before it gains its full-grown voracious conditions, and even as matter of curiosity the main points of the changes appeared worth record when I had the rare opportunity of observing them.

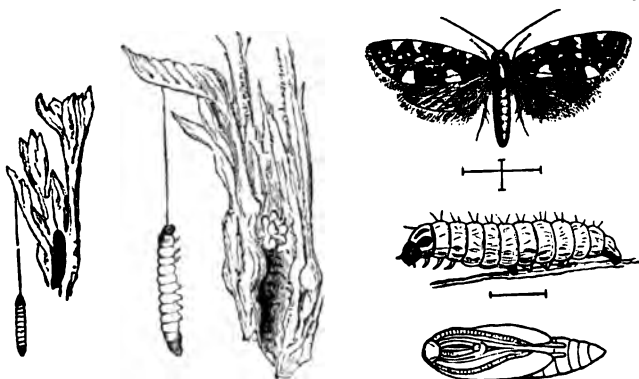
PREVENTION AND REMEDY.—Excepting where the attack occurs to very young trees or in nurseries, where, as noted at p. 116, the plants are so small that they quite fail under attack, there seems to be little need of taking measures against this infestation.

* The above figure is mainly copied from that given at Plate xxxii. fig. 4, c, of 'Larve of British Butterflies and Moths,' but with comparison with my own specimen. The smaller figure is copied from 4, b, of the same plate, and indicates the appearance of the tubercles behind the head seen from above.

The caterpillars are of such a great size for some time before they have attained their full growth that, when the operator's eye has become accustomed to distinguish between their green tints and that of the leafage, they may be very easily hand-picked off trees still small enough to lie much under their powers of doing mischief. Attention would be drawn to some creature requiring removal being present, by the gnawed state of the leafage, and whether in the black and yellow or purplish and green condition it should be cleared.

RASPBERRY.

Raspberry Stem-bud Caterpillar. *Lampronia rubiella*, Bjerk.



LAMPRONIA RUBIELLA.—Moth, magnified, and with lines showing natural size; caterpillars, natural size, and somewhat magnified from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood.

The attacks of the little red caterpillars of the small moth (figured above) scientifically known as the *Lampronia rubiella* sometimes cause serious damage by their workings within the buds and young shoots on the Raspberry canes early in the season. The mischief is begun in spring by the young caterpillars (which have lived in caterpillar state throughout the winter) making their way into the young leaf-buds, and, as the season advances, the injury that is going forward becomes very noticeable by the fading of the young shoots which have grown from attacked buds, or are themselves undergoing attack.

The infestation is not of yearly recurrence to an important extent, but it is one of long standing, certainly since as far back as 1858. It has only twice been reported to myself as serious, namely, in 1883, and

again in 1891, in which latter year it was present at a good many English localities, and also near Glasgow and near Crieff in Scotland.

In the past season I had some slight mention of the infestation being present at Loughborough and at Rugby in England, but notes were also sent me from Carluke, Co. Lanark, N.B., of the Raspberry growers in that district being so greatly troubled by the appearance of the caterpillar in their plantations, and the damage being caused by it to the buds on the canes, that some further observations on the life-history of the infestation appear to be needed.

The commencement of the life-history of this infestation *does not take place* when the mischief from it (as above) is first noticed, but in the *preceding summer*. The moths lay their eggs in the "receptacle" of the open Raspberry flower, the eggs being deposited about their own width below the surface of the receptacle.* There the maggots or caterpillars hatch, and feed in the gradually forming white fleshy "receptacle" until the Raspberry is ripe, when they are full-fed, and leave their feeding ground. This may either happen by their simply going away, or by boring an exit-hole out at the base by the footstalk. They then go down to the stool of the plant, and spin a little round flat white silk cocoon, not much more than the twelfth of an inch in diameter, in which they pass the winter.

This is the first part of the life-history, which is seldom noticed, because the presence of the little caterpillars in the white "receptacle" does not appear to interfere with the development or with the ripening of the fruit, and the above points—that is, the locality where the moth (which is known to be common in June) *lays her eggs*, and where the young caterpillars feed until they shelter for the winter—were, I believe, unknown (or only vaguely and in very small part noted) until observed and recorded in 1891 by Dr. T. A. Chapman, of Hereford.†

With the following spring *the second part of the attack begins*; the little caterpillars come out from their cocoons, and mount the canes, and proceed to attack the buds and do mischief, but with some variety in the method of their operations. When the attack is in progress, the maggots (larvæ) may be found crawling on the canes, and some emerging from the buds (to renew attack at pleasure), also some of the buds may be found burrowed from base to top, and some with a maggot still within them. As the attack, or rather as the season, advances *young shoots* will be found failing from the presence of the pest within, so that I have had notes of shoots failing up to the extent of ten to

* The "receptacle" may be generally described as the central part of the Raspberry flower, which in due time enlarges into a white somewhat cone-shaped mass occupying the centre of the Raspberry fruit.

† See "The Oviposition and Autumnal Larva of *Lampronia rubiella*," by Dr. T. A. Chapman, in 'The Entomologist's Magazine' for June, 1891, p. 169.

fifteen acres of plants being so damaged that they appeared as if frost-bitten, and also of shoots infested by the larva of this *Lampronia rubiella* being gathered by basketfuls. This collection was made on May 12th.

At May 18th I have had specimens sent me of the caterpillars then beginning to spin up and change to the chrysalis state. So far as I have seen, this change takes place in a bud, but it may very possibly occur in the cane if the maggot has bored from the bud into it, or in the young shoot—in fact, wherever the caterpillar may have been carrying on its destructive work.

The Raspberry Stem-bud Moth caterpillars are about a quarter of an inch long, of some shade of red, with black head, and black mark on the following segment; they have three pairs of claw-feet, which are black, and also four pairs of sucker-feet, and a pair at the end of the tail. When examined through a magnifying glass it will be seen that there is a pale line down the centre of the black head, and that the mark on the following segment is composed of a pair of double-spots.

Of the caterpillars sent me on May 18th, noted above, one had spun up, excepting at the head end, the colour beneath having become yellower. A chrysalis (spun up in web in the bud) was tawny or reddish yellow on as much of the back from the head onwards as was visible. The wings, which were folded beneath it, were yellowish. The abdomen was of a full pink.

The above observation was satisfactorily completed by a characteristic specimen of the moth, *Lampronia rubiella*, developing from a chrysalis in one of the Raspberry buds sent me. This I first observed to have emerged on June 1st.

The following are the main characteristics of the appearance of the moth; see also figure at p. 119:—The expanse of the wings is a little under half an inch. The head ochrey grey with yellowish face; horns dull brown. The fore wings shiny, with a brown ground, marked with yellow dots and various yellow spots; of these spots two are very noticeable on the hinder or inner margin, and there are four smaller spots on the costa or fore edge. The fringes are brown, with tips white at the end of the wing. The hinder wings brown, with paler fringes.

From the notes of life-history given above, it will be seen that this is what may be well described as an attack in *two parts*. *The first is the summer to autumn part*, from the opening of the Raspberry flower to the ripening of the fruit, in which no observable damage is done, but still the foundation of the future mischief is laid. Winter is a time of quiescence of the infestation in its little cocoons. *The second part is the spring to summer attack*, of which the damage is well known.

This begins with the swelling of the Raspberry buds, or even earlier, and continues till the caterpillars spin up; the moths from the chrysalids coming out at the season of the opening of the Raspberry flowers.

This life-history, as we know it now, and for which in its early part we are mainly indebted to Dr. Chapman, gives us the key for practical operations on the pest, for want of knowledge of which, as will be seen by some of the following observations, both loss of crop and disappointment from unsuccessful attempts at remedial measures, were incurred even in the past season.

In the past season the report of attack at Loughborough merely referred to the specimens sent accompanying, and which proved to be of the *Lampronia rubiella*, as a kind of infestation with which the sender was previously unacquainted, and which was injurious to Raspberry canes by boring into the young shoots, and thus slowly killing them. The date of communication was May 12th.

In the following observations, sent me rather later in the month than the above, on May 28rd, by Mr. W. T. Fisher, from Clifton Road, Rugby, it will be seen that he especially draws attention to having found many of the scarlet caterpillars of *L. rubiella*, not only on the Raspberry canes themselves, but also on the "young shoots coming up from the ground." I do not remember that this circumstance has ever been recorded previously, and if on investigation it should prove to be a common habit of the caterpillar to work in the young shoots from the ground, as well as in the young shoots from the canes, it would be a point well worth attention. Mr. Fisher remarked as follows:—

"*Lampronia rubiella*.—I have found a great quantity of these scarlet pests on my Raspberry canes this spring. Every withered shoot has been most religiously removed and burnt at once, but on looking over them myself, I noticed that it is not sufficient to look over the canes themselves merely, but the young shoots coming up from the ground also require the keenest scrutiny if the greatest benefit possible is desired from the labour expended. I estimate that from ten to eighteen per cent. of the total destroyed came from this source, so that, if these had been neglected, a relatively large number would have been left to propagate the mischief next year."—(W. T. F.)

On April 26th information was requested from me by Mr. Robert Scott, of the firm of Messrs. R. and W. Scott, of the Clydesdale Preserve Works, Carlisle, Co. Lanark, regarding presence of the same infestation (namely, *Lampronia rubiella*, of which specimens were sent) to a serious extent in the Raspberry plantations in the district; and amongst other points it will be seen that available information was still so much needed that what may be called double loss was being

occasioned; this being partly from the attack not being checked, and partly also by the attempted remedies causing injury to the plants. Several points of interest were mentioned, and amongst them the circumstance that the Raspberry canes throw out secondary shoots from the base of the injured buds, and thus a moderate crop was secured from the infested canes, although somewhat late in date. The first of Mr. R. Scott's communications, sent me on April 26th, was as follows:—

“The Raspberry growers around this district are being seriously perturbed over the appearance in their plantations of a small red caterpillar, which exhibits a marked liking for the buds of the Raspberry canes. I am sending per parcel post a number of short lengths of canes, which show manner of attack. The writer is of the opinion it is the Raspberry Moth caterpillar, as detailed in one of your Reports some years ago, but as said Report has gone amissing, reference cannot be obtained. The chief matter in doubt at present amongst growers is the condition and situation in which the caterpillar hibernates. It is presumed that it is in the ground, but the caterpillar being so small and the numbers on the canes so great, many are disposed to doubt this. If the Report has impressed me correctly, the caterpillars hatch out in the summer, and, passing into the ground, hibernate there until they appear, still in the caterpillar form,* in the following spring. To meet this condition of things, a number of growers tried gas-lime around the stools, but with disastrous results to the following crop, as a very large percentage of bearing canes never started a bud, and those that did start were much feebler and later than usual. It is probable, however, that the quantity of gas-lime, eight to twelve tons per acre, was too large a dressing. Spraying has been adopted, Paris-green and quassia chip solution, but, so far, I rather think the result is not up to expectations. For one thing, spraying was too late in being done, caterpillars being safely hidden inside the buds. The only redeeming feature is that, while the first buds may be irretrievably ruined, the Raspberry canes throw out secondary buds from the base of old buds, and these give a moderate crop, although later than the original buds would have yielded.

“The form in which canes are tied in this district is no doubt rather in favour of attack. Either the canes of each stool are taken and tied somewhat firmly (practically in a bunch), or else half of the canes from each of the stools are brought together in the form of an arch, and tied in that position. Under such conditions caterpillars

* It will be seen that the above observations are very nearly although not quite correct. The caterpillars *do go down* from the Raspberry fruit when full-fed, but the spinning up for hibernation has not been recorded as taking place anywhere excepting on the stool.

have free access from one cane to another, no isolation of individual canes being possible, as would be the case where canes are spread out fan-shape on wires."

On May 14th Mr. R. Scott communicated further regarding the date of the first observation of presence:—

"This moth, until about six years ago, was unknown in the district around here; but about that time one or two growers purchased Raspberry canes (rooted) for planting purposes from England, and it would appear that the infestation was introduced from that quarter, the more so as the grower most badly attacked at the beginning was one of the purchasers referred to."—(R. S.)

On July 6th Mr. Scott noted as follows:—

"The Raspberry Moth, about which I wrote you previously, has been pretty generally destructive all over the district, but from my own experience and the experience of others, I should say that the damage is not nearly so great as was once feared. The secondary buds that started from the base of the buds destroyed have come away nicely since the rain fell, and, though the fruit will be a little later, it is not likely to show the sad shortage of crop that so many had anticipated."—(R. S.)

PREVENTION AND REMEDIES.—One of the most effectual methods of checking *recurrence* of attack must certainly be that mentioned above, of breaking off the infested buds, or little shoots, and destroying them. On an occasion of a visit of the Evesham Fruit Experimental Committee to the Toddington Fruit Grounds on May 12th, a large basket was shown filled with Raspberry shoots infested by caterpillars of *L. rubiella*, as a sample of several other basketfuls which had been collected in the previous part of the day, and sweeping clearances of this kind cannot fail to make much difference in the amount of recurrence of the infestation.

This method of clearing the pest, however (as previously mentioned in my 'Handbook of Orchard and Bush Fruit Insects,' p. 210), requires some care in carrying out, for, as has been shown, the caterpillar by no means necessarily remains in its own bud. To prevent escape, the buds, or embryo shoots, might be cut into pails with a mixture of soft-soap or of any sticky fluid in them which would prevent the caterpillar crawling away, or a rough lining of canvas to the collecting baskets which would allow of a good sprinkling of paraffin oil (or of anything that the grubs would not cross at the edges), would probably be a good plan.

In any case the broken-off buds and shoots should be burnt or destroyed in some way as soon as possible, or otherwise, in case the caterpillars are so nearly full-grown as for the time of their change to

chrysalis state to be at hand, almost as plentiful a development of the moth may be expected from the gathered shoots as if they had remained on the bushes.

Excepting in the case of the experiment noted at p. 123, no deterrent measures appear to have been tried with regard to the establishment of little red caterpillars when they *come down* to the old stools from the ripe Raspberry fruit to spin their little cocoons on them for hibernation; nor when they *come out* from these cocoons on the stools (or it may be also from other sheltering-places where they have passed the winter) for their attack on the buds of the canes. But when there was reason to expect bad attack, it might for one thing be worth while to try the effect of some preventive dressing thrown round the bases of the canes; and also a much more complete removal of old stumps and rubbish and everything that would shelter the infestation in its winter state than is commonly carried out, would certainly be very helpful in getting rid of a deal of coming infestation.

In regard to preventive applications when the caterpillars are coming down to spin (that is, presuming that the method of growth allowed the stools to be got at without unreasonable trouble), it might be worth while to syringe a solution of soft-soap and water amongst the stumps of the old stools and rubbish. Or it might help a good deal to throw a dressing at the bottom of each plant of some dry material mixed with paraffin at the rate of a quart of the mineral oil to a bushel of ashes, dry earth, or whatever might be thought best to use. We know from broadscale trial that the paraffin in the above proportion did no harm to the tender shoots of Hops coming up through it, and therefore there does not appear reason to fear that it would be injurious to the Raspberry stems in any stage, and it might have a very good effect in preventing establishment of the caterpillars when they come down, and very likely, if established, lessen the numbers going up again in spring.

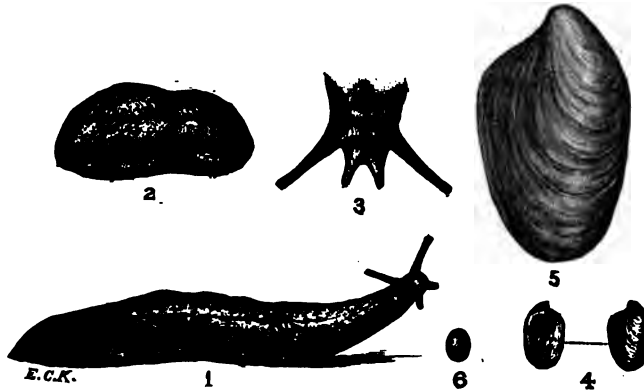
For ground dressing, where it is thought desirable to try this (as some cocoons may be spun on rubbish on the surface), some kind of application would be best that is known by common practice to be harmless to plant health if used in ordinary amount, also that acts as a stimulant to growth, and also which it *may be hoped* will act as a deterrent on progress towards development of the young caterpillars. Nitrate of soda, sprinkled in an amount representing an ordinary top-dressing for field use on the surface beneath which maggots of the Pear-tree Midge had gone down to change, was found to act so that not more than ten per cent. were alive, so far as examined subsequently, in their cocoons. Kainite, applied from "sprinkling with a small quantity" experimentally up to a "heavy top-dressing," or at the rate of over half a ton per acre on orchard land, had still better

effects. The maggots, in the instances examined, were found *dead* "in their cocoons." The cocoon in which the Pear Midge Maggot passes the winter (for it does not change to chrysalis in it until early spring) is spun of silk, covered with grains of sand, and, as the rather slighter silk cocoons of the Raspberry caterpillars appear to offer no better defence from action of surrounding chemicals, a trial of effect of an autumn dressing might be well worth while. Notes on the successful effect of kainite as a preventive dressing for Pear Midge infestation will be found preceding, under this heading.

SNAIL-SLUG.

(BENEFICIAL.)

Snail-slug. *Testacella haliotidea*, Draparnaud.



TESTACELLA HALIOTIDEA.—1, Snail-slug, in motion; 2, contracted; 3, head, with tentacles, magnified; 4, shell, upper and under side, slightly magnified; 5, shell, much magnified; 6, egg. (4 and 6 from plate v. of Jeffrey's 'British Conchology,' vol. i.; the other figures from specimens taken at St. Albans.)

The Snail-slug greatly resembles several kinds of our common garden and field Slugs, but is distinguishable from them by having a small external shell placed near the end of the tail. From this circumstance of possession of a noticeable shell (although certainly it is a very little one) the creature takes its popular name of the Snail-slug; but, so far as my own experience goes, the point which most frequently attracts attention to these Snail-slugs not being of the common plant-eating kinds is their being found in the act of swallowing,

or in some way or other to be, or very recently having been, feeding on an Earthworm.

The *Testacellæ* differ so entirely in nature of food from our common Slugs, that they are beneficial to us by ridding us of small ground vermin; they are wholly *carnivorous*, and prey chiefly on Earthworms, but also on Slugs and Snails, and even on each other.

During the day they live mostly underground, and are to be found in gardens, and at the foot of old walls, by roots of plants, &c. How far they may come to the surface at night to feed does not seem clear; they are recorded as sometimes coming to the surface in breeding time; also it is said that the *Testacella* only sallies out at night in search of prey; also it is said that those who wish to procure specimens should look for them at daybreak, especially after a warm dewy night in the months of July and August. But whatever variations may occur as to coming to the surface by night, there appears no doubt that as a regular thing they live underground by day. *Through* the ground beneath the surface they hunt the Worms on which they principally feed, their great compressibility of body, and also their power of lengthening or contracting themselves at will, giving them great facilities of movement, and after having gorged themselves they can remain for a fortnight or more without food.

Heavy rains destroy great numbers of them, but cold is stated not to do them harm, and as a protection when cold winds are prevalent, they are recorded as enclosing themselves in a kind of case formed of slime secreted by the skin, and often mixed with extraneous particles. In winter they bury themselves very deep in the ground.

The average length of life is considered to be five or six years, and they multiply by eggs which are laid separately, and are very large in proportion to the body.

The *Testacella haliotideæ* (figured from life at p. 126) is, when full-grown, as much as three inches in length, and four-tenths of an inch in width. The body firm in texture, cylindrical, and very flexible, contracted towards the front, and somewhat broader behind the middle, capable of extending itself like a worm, and the skin smooth when the animal is crawling at full length, transversely wrinkled when at rest. The back convex, divided longitudinally into three nearly equal parts by two grooves, which run along each side from the front edge of the shell to within a short distance of the tentacles, or horns. These longitudinal grooves have (*typically*) transverse lines running downwards from them; but in my specimen, though the long grooves were plainly observable, the offsets of lesser lines were not noticeable; this very probably from the Slug having been for some days not in natural circumstances.

The colour is very variable, but is generally described as yellowish

brown, mottled with black, red, or white. Tentacles (horns) four; eyes placed not quite at the tips of the upper pair; and beneath the much shorter *lower* pair of tentacles are a pair of processes much shorter and thicker, which are technically the "lips," or "labial palpi," and are flexible and extensible. These are not given (consequently on position) in my figures.

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which enables the *Testacella* to retain a firm hold of its victim, and swallow it more easily."

On Sept. 21st, 1897, I received a short note from a correspondent (living at Aylesbury, Bucks) mentioning, in the course of other communication:—

"I may say that we dug up in the spring an unusual number of Slugs, owing, I presume, to the mildness of the late winter and absence of frost. We found two or three specimens of a hard Slug with a small Worm half down his throat. I was not aware they lived on these things."—(J. W.)

Here we have another illustration of the habits of the Snail-slugs of living underground and preying on Worms. In this instance, as I did not see specimens, I cannot tell which of the two species of *Testacella* that are found in Britain might be referred to. Only two distinct species are recorded, namely, *T. haliotidea*, which is by far the best known, and *T. maugei* of Ferussac, which is noted as being found established during a long course of years at the gardens of a nursery firm at Bristol, and likewise at a garden at Swansea occasionally supplied from the above gardens, likewise at a few other places. This species has a smaller head, as well as "*a much larger and more convex (almost semi-cylindrical) shell than haliotidea.*"—(J. G. J.)

On April 25th in the past year (1899), I was kindly favoured by Miss F. Curtis with the following observation on presence of Snail-slugs in the gardens at Potterill, Hatfield, Herts, which it will be seen embodies in a few words three noticeable points regarding their habits—namely, that they are constantly present in the earth, but *hide in the daytime*; likewise that they have been observed *in the act* of swallowing Worms. In Miss Curtis's own words:—"The gardeners constantly find them in the earth, and have seen them swallow Worms, but they generally hide in the daytime."

In reply to my enquiries whether Miss Curtis could be good enough to furnish me with any more information on the subject, she mentioned that the gardener, who was the special observer of the *Testacella*, said:—

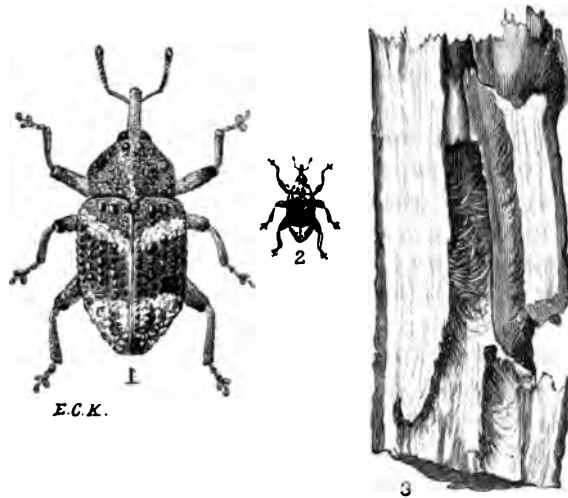
"They never saw any in this garden till about ten years ago, and then they were found near an old Quince tree. Now they have seen as many as ten together in a small piece of ground, and though they scarcely ever find them, except when they are turning over the ground (about three or four inches below the surface), the one sent me was picked up off the top of the soil. The gardener thinks they lie dormant in winter time, and he has noticed little dents in the soil where they have lain. When they cut one of them in half, they found a long Worm inside!"—(F. C.)

Those who wish to follow up details in a fairly accessible publica-

tion, will find much of interest in Prof. Gwyn Jeffreys' 'Conchology,' referred to at p. 128, where also a large number of references are given—names of writers, or observers, of the *Testacellæ*, from 1740 onwards. But I am not aware of what may be called practical notes of observations of the creatures *in situ* in our own gardens having been given attainably for reference, and the very useful though unpossessing creatures appear to be usually so wholly unknown to their garden observers, that the above notes may be of service in pointing out that, though unpleasant in appearance and disgusting in the details of their Worm-feeding habits, they are really very useful.

WILLOW.

The **Mottled Willow Weevil.** *Cryptorhynchus lapathi*, L.
 "Alder-killer" (German).



CRYPTORHYNCHUS LAPATHI.—Beetle, natural size and magnified; Willow stem tunneled by larvæ.

The very pretty little beetle figured above is not often reported as causing much harm, but it is widely distributed in England, and to some degree in the more southerly parts of Scotland, and was known as injurious to Willows at least so far back in date as about 1840.

The Willow is the tree which is recorded as most liable to its attacks. In 1838* it is mentioned as exceedingly abundant in the

* See Loudon's 'Arboretum et Fruticetum,' vol. iii. p. 14.

Osier beds near Barnes and Mortlake; and in Selby's 'Forest Trees' (published 1842), at p. 165, it is mentioned by the writer that he had personally observed young trees of Willow attacked, and the wood "riddled," as it were, by the grub of *C. lapathi*. Alders are also subject to attack; and in German observation Poplars and Birch are also mentioned as liable to infestation. So also is a species of Dock (*Rumex*)* from which circumstance the specific appellation of *lapathi* has been given; but the correctness of the observation of the weevil being feeding on the Dock (and not merely chancing to be on the plants when growing under Willows) has been doubted.

At the end of October, in the past season, Mr. Alex. G. Higgins, writing from Bexhill-on-Sea, Sussex, favoured me with the following notes regarding attack to Willow, with specimens accompanying of the injury caused by infestation to some small Willow stems, from a part of one of which the figure (p. 131), showing the destructive extent to which it had been tunnelled, is taken. Mr. Higgins remarked as follows:—

"I am sending you with this a box containing a couple of sections of good-sized shoots of Willow (the long narrow-leaved variety), and you will perceive them, one in particular, to be tunnelled, principally in the axis of the shoot, with short stout tunnels, which, in the recent state, were filled with frass. What I believe to be exit-holes may be seen on the outside bark.

"In some of the tunnels, at one or other end, and dammed up by the frass, I found, in some cases, the larva, more commonly the yellow soft-bodied pupa, and much more frequently the perfect 'imago,' one of which I enclose.

"As to any evidence of destructiveness, . . . I can only say that on the small shrub-like Willow plant I took the accompanying specimens from, there were no very marked signs of internal insect ravages, except the frass-plugged holes through the bark; that is to say, but few branches had died, and the foliage had apparently not suffered. All the same, . . . I should judge the tree will be ultimately killed, perhaps in two or three years' time.

"In the smaller of the two shoots, the single cavity there was

* *Lapathum* of Tournefort is the scientific name of one of the two sections of the genus *Rumex*, Linn., of the great order *Polygonaceæ*. Most of the species of *Rumex* are known popularly as "Docks," with some prefix, as "Curled Dock," "Sharp Dock," &c., and as some are especially to be found in watery places, it seems likely enough that *Cryptorhynchus lapathi*, which frequents Willows and Alders, should be found sometimes on these moisture-loving plants also. But as it is not obvious at a glance what connection there may be between the specific name of *C. lapathi* and a "Dock," the above note may be of some interest.

For botanical reference, see Sowerby's 'English Botany, vol. viii. p. 40; also Babington's 'Manual of British Botany,' p. 271.

occupied by a dead and disintegrating 'larva,' and presumably the egg was laid in or about the bud, towards which the short cavity is directed."

On Nov. 1st, Mr. Alex. Higgins noted further:—

"Since writing, I have got a number more of infested shoots all of which are from Willow, and the selection of *Willow* is the more marked, as in the immediate neighbourhood there is abundance of both Poplar and Sallow.

"I noticed, in handling some rather lively specimens of the beetle this evening, that they very frequently, when touched or otherwise annoyed (?), give rise to faint but definite squeaks not at all unlike the sounds produced when an indiarubber doll is squeezed (in quality only, of course). This, of course, is but an example of many similar in the insect world—as, for instance, in '*atropos*.'"

In the above notes the mention of the especial selection of Willow for attack, although in proximity with Poplar and Sallow, is of interest; and so also is the observation of the beetles giving rise to a squeak-like noise on disturbance.

Of this peculiar sound, it is noted by Prof. Westwood *:—"According to Lister, this insect emits a querulous sound when alarmed (*De Scar. Brit. App. Hist. Ins. Raii*). This noise is produced by rubbing the base of the prothorax against the narrowed front part of the mesothorax."

In vol. iii. of London's '*Arboretum et Fruticetum*,' at p. 1480, is given what I presume to be the same information, though rather differently worded, from the Ashmolean Appendix to Ray's '*Historia Insectorum*.' Here it is recorded that "it possesses, though feebly, the faculty of voice"; and the statement, "*Lacessitus, vocem querulem dedit*" (that "on being disturbed or provoked, it makes a querulous noise"), agrees with the observation that I was favoured with from Bexhill (see above). It would be of a good deal of interest to have some more observations as to this noise, and the method of its production, for in all the modern accounts of the beetle's habits which I have opportunity of consulting, I have not found any allusion to this power of emitting sound.

The beetle is about the third of an inch in length, rough, the ground colour black, but with the sides of the thorax, a more or less irregular transverse band near the base of the wing-cases, and about a third of their length from the tip, of a yellowish colour. The thorax with the sides rounded, and coarsely punctured, the front portion bearing little bunches of bright black scales. The wing-cases with the band at base varied with black or fuscous, and punctate; the

* '*Introduction to Classification of Insects*,' by J. O. Westwood vol. i. p. 344.

punctures of the striæ *very large*; the interstices closely punctured; the third, fifth, and seventh furnished, like the thorax, with bunches of bright black scales. Head black; proboscis stout, and slightly curved, and, when at rest, fitted beneath the thorax; horns reddish, elbowed, and terminated by an ovate club. Legs black; in the specimens before me more or less marked or banded with ochreous, especially on the thighs of the fore legs. Wings transparent, with strong veins, those at the lower part chestnut coloured.

The above notes give a fair description of the appearance of the beetle as seen natural size or slightly magnified; but (when under a powerful magnifier) the marking will be seen to be elaborately and delicately varied. The black thorax has three longitudinal lines of yellowish colour more or less present; and the wing-cases have variations of black dots on the yellow-tinted apical portion; and other distributions of whitish or yellowish tints, together with the large shallow punctures of the striæ, on the wing-cases, and the bright black bunches of scales, give a variety to the appearance almost impossible to describe.

The larva, or grub, is stated to be very like that of the Pine Weevil (*Hylobius abietis*). It is about half an inch long, body whitish, sprinkled with bristly hairs standing well apart, with two longer bristles at the hinder angles of the tail extremity. The three rings behind the head are swelled beneath, with a semicircular enlargement on each side bearing a bristly hair.

The beetles are to be found pairing on shoots (as of Sallow or Willow) at the end of April and beginning of May, and it is observed that, whether singly or in pairs, they will fall to the ground on the slightest shake, and lie there for a long time as if dead. During the period of its existence in beetle state the infestation does some amount of harm, but the mischief from this cause is not by any means necessarily serious, as the duration of life-time is limited.

The life-history, put shortly, is that the females lay their eggs singly on the stems of their food-plants; in about fourteen days the larvæ hatch, and, after gnawing under the bark, bore tunnels in the wood, leaving the rubbish or dirt from their gnawings pressed together behind them. As the larva increases in size, the brown "boring chips" and excrement are thrown out at the aperture of the boring. So far as is shown by published descriptions and figures, and comparison with such specimens as I possess, the tunnelling in the wood of the small stems has no marked characteristic; the galleries may run parallel along the inner part of the stem (as shown in the figure, from life, at p. 181, of a Willow stem an inch in diameter), or they may take a slightly winding course.

In the figure now before me (in 'Forest Protection,' by Prof.

R. Fisher, p. 199) of larval burrows of *C. lapathi* causing injury an Alder stem, about three-quarters of an inch across, they may in a more or less slanting direction from one side of the stem the other. In these galleries the frass, or "bore-chips," is very noticeable, and so is the condition of the *outside* of the shoot after the attack.

In the piece of Willow stem before me, taking the half circumference of the split stem, one inch in diameter, there are four large orifices to tunnels in a length of four inches. The holes themselves are about a quarter of an inch across, but the discoloration and injured state of the surrounding bark makes them very conspicuous. Each hole is in a small brown tunnel-shaped cavity apparently formed by sawing, and round each external orifice is a slightly raised border of own bark, forming (for much of the circumference) a thoroughly fined ring of about an eighth of an inch in width; at the other part the border is of much greater size. It is irregularly enlarged to a own patch of nearly three-quarters of an inch in length from the orifice, and of varied and irregular width, up to as much as half an inch or more, and along the centre of this enlarged part the bark is split into an irregular fissure. The figure given by Dr. Bernard Altum accompanying his notes on the attack of this *C. lapathi* gives a good idea of the appearance of these rings of injured bark.*

Within these tunnels the larvæ turn to pupal state, and thence to the developed beetles; but how long the period may be that is required for the transformation is a point on which different opinions are expressed by the two well-known German writers to whom we are indebted for *detailed observations* of the life-history.

Dr. Taschenberg † considers that *customarily* the generation is of *one year*, the larvæ being to be found in August, and completing development before winter, but still that this is not always the case.

Dr. Bernard Altum (see reference below) states that the larval attack is in two distinct parts. Firstly, that of the superficial attack under the bark in the first summer; and *after* hibernation, the second stage of attack into the sound wood occurs in the second summer. Consequently these insects have a *two years' generation*" (B. A.). Every minute details will be found given in the papers referred to, but believe the above is sufficient for general purposes.

PREVENTION AND REMEDY.—Examining whether signs of infestation are present in the stems, and, if so, cutting down (so far as is possible) all that show presence of it, and burning them, before the beetles are

* See 'Forst-Zoologie,' von Dr. Bernard Altum, vol. iii., Insekten, pt. i. 208.

† See 'Praktische Insektenkunde,' pt. ii. p. 161.

sufficiently developed to have emerged—from August onwards. Where the attack is prevalent to any important degree, it would also be desirable to split some stems longitudinally during late winter or early spring to ascertain whether larval attack is present. We may need more information on this head.

Where beetles are seen numerously on leafage, beating down would be a good remedial measure. In Canon Fowler's 'British Coleoptera,' vol. v. p. 829, he mentions that "the perfect insect appears to be to a certain extent crepuscular, and that he has found the males and females together in numbers in an Osier bed near Repton, Burton-on-Trent, at half-past four or five on a summer's morning; but they appeared to be scarce in the middle of the day, or in the afternoon in the same locality." It would therefore be well, as in the case of beating down Chafers, to make sure at what time the beetles are to be found, and then, if shaken on to tarred cloths, or into pails with some mixture that they could not escape from arranged for them to fall into, probably great numbers could be got rid of.

SHORT NOTICES.

IN this, the first part of my Second Series of Observations of Injurious Insects, I have varied from the original plan of arrangement, by giving, under the above heading of "Short Notices," such isolated notes on appearance, habits, treatment, or remedial measures, of insects previously referred to, as convey additional serviceable information to that of the detailed and illustrated observations, given at length in my previous series of Twenty-two Annual Reports.

Thus we secure notes of interest, which in due time may be used for completion of the previous observations, without repetition of matter which is unnecessary to the regular recipients of my Annual Reports; and to others, who may wish to study the subject *in extenso*, is procurable by means of the references to Annual Reports,* in which the chief observations have been given which are appended to each notice.

APPLE.

Eye-spotted Bud Moth. *Tmetocera ocellana*, Schiff.

The caterpillars of the Bud Moth do much harm in America by feeding on the leaves and buds of Apple and other fruit trees, whilst still in early state of growth, and spinning them together. Until the past season I had only received a single report of observation of this attack, but now, however, it seems desirable to draw attention to it, partly because just a few notes of its *demonstrable* presence were sent me, and partly because an idea was to some degree prevalent that much mischief in various fruit gardens and plantations was attributable to this cause.

On April 23rd I was favoured by a communication from Mr. W. E. Bear that he had found brown caterpillars on trees in his garden at Highgate which agreed so precisely in appearance and method of

* See advertisement of Index to twenty-two preceding Reports on, wrapper.

working with those of this infestation that there was no reason to doubt their identity. He noted them as "dreadful pests."

On April 27th I had a note from Mr. Cecil H. Hooper, of finding the attack in his orchard at Highlands, Swanley, Kent, and as he mentioned that he "saw lots of it in Nova Scotia" in the previous year, this also is presumably an accurate identification.

A third observation, which I believe to have been quite correct, was sent me on April 28th from Charsfield, Wickham Market, Suffolk, and in this instance a good supply of caterpillars were sent me for identification.

A list of about a dozen places was sent me where this Bud Moth attack was believed to be the cause of mischief present on fruit trees; but, as I had neither details nor specimens of the attacked and infested young leafage or buds for technical examination, I am wholly unable to offer a trustworthy opinion on the matter. This more particularly as there is another attack, that of the very small reddish or brownish caterpillars of the "Pith Moth" (*Laverna atra*), which, though it differs from the above in *method* of damage (as this is carried on by working up the centre of the stems just below the bunches of Apple blossom), yet to some degree has a resemblance in its *effects*. The bunches of budding blossoms and of young leaves are to be found withered and destroyed by effects of the Pith Moth attack, though not spun together, as with that of the Bud Moth.

It would probably be very useful to Apple growers to know more about these attacks, and especially whether that of the Bud Moth is really prevalent, and, if I should be favoured with specimens, I would gladly give full attention and report to the senders. But I would earnestly beg that they would let me have some samples of the spun-together or injured state of the young leaves and blossom buds, for it is an absolute impossibility to identify from a caterpillar or two, perhaps not a quarter of an inch long, and in unnatural conditions very likely affecting the colours.

The following notes convey a short description of the history during the year of the Bud Moth infestation.

About August or September the little caterpillars, which are then not more than the sixth of an inch in length, desert the leaves of the Apple or other trees on which they have been feeding, and, creeping to the twigs, spin silken cases in which they pass the winter.

In spring the caterpillars, which are of a brown colour, with nearly black head, and black plate on the next ring, come out of their cases and proceed to eat into the nearest swelling and opening leaf-bud, or possibly they time their attack a little later, when the buds are about half opened, and feed on the central expanding leaves and flowers, tying them together with their silken threads. At this stage

of attack the brown colour of the injured and spun-up leaves is a guide to the nature of the mischief that is going forwards.

The caterpillars continue to feed for about six or seven weeks, and when full grown, when they are about half an inch long and slightly hairy, spin up a shelter of one or more leaves or pieces of injured leaves, which they line with silk, and in their separate "nests" they turn to chrysalis state, from which, so far as noticed with us, the moths come out between June 8th and 20th.

The little moths are only about half an inch or rather more in the expanse of the fore wings, and are of a general ashy grey colour, with a broad white band or blotch across the fore wings, whence the name of the "Eye-spot" Bud Moth. Egg-laying is considered to begin, *on the leaves*, in about three or four days, and hatching to take place in rather more than a week afterwards, when the caterpillars proceed to feed on the leaves (commonly on the under side), and, before the fall of the leaves, desert them (as above mentioned), and, removing to the twigs, spin their winter cases.

The best method of prevention is breaking off and burning the bunches of destroyed and spun-up leafage and buds; but if this attack has really become prevalent, it can be very easily recognized by the above description, and I would gladly attend to any enquiries sent with specimens of the injury. (See 'Report of Observations of Injurious Insects' for 1889, pp. 81-84; and for 1898, pp. 5-9.)

BEECH.

Beech-bark Felt-scale. *Cryptococcus fagi*, Baerensprung.

This infestation appears in the shape of a white felt-like or flocculent coating, to be found on bark of Beech trees, sometimes as a mere film, but characteristically in a coating up to as much or more than an eighth of an inch in thickness, formed of aggregations of white irregular lumps, giving the general appearance of rough lumpy white-wash having been thrown at the tree, and sometimes protruding through small cracks in the bark.

Within this soft white matter the little *Coccids* may be found numerously present, lying sometimes singly, sometimes several near together. They are soft-bodied, of some shade of yellow varying from pale to reddish yellow, and so exceedingly small (not being at the largest size as much as half a line in length) that their details are not observable by the naked eye. With a good magnifier the females will be seen to be almost circular in shape, with markings on the fore-part of the abdomen hardly discernible; antennæ a mere stump; first and second pairs of legs wanting, and the third pair merely a papillar

stump. Eggs are to be found in process of laying in June, probably much earlier, as I have found larvæ present on July 4th. In larval state they are found with the abdomen distinctly segmented; antennæ five-jointed; and legs strong, the thighs as long as the shank and foot.

The possession of a *rostrum* or *proboscis*, by means of which the *cocci* suck away the juices from the trees, is a very important part of their structure. They belong to the division which includes the "Scale Insects," but are more nearly allied to the soft fleshy kind known as the "Mealy Bug," than to those which (like the Mussel Scale of our Apple trees, for instance) are covered by a horny "scale."

The infestation is widely distributed in England, and where it is allowed to establish itself is very destructive to Beech trees, singly or collectively, as in Beech woods, and in the past season I had two notes of the application of paraffin acting very well as a remedial measure.

On April 8th Mr. J. Lansdell, writing from The Gardens, Barkby Hall, near Leicester, informed me that the Beech trees in that neighbourhood were very badly attacked by this Felt-scale (of which he enclosed specimens) and many of them had been killed. In order to save a large Copper Beech which had been badly attacked, Mr. Lansdell made a paraffin emulsion, of two pounds of soft soap to a quart of paraffin, diluted with twelve gallons of wafer. This was *taken up the tree above all the insects*, and the branches and stem thoroughly washed with it (applied by a new scrubbing brush). This (which was done about five years ago) completely destroyed all the insects, and the tree continues quite healthy. The tree being a very fine one with many large branches, the work took one man nearly all one day, but Mr. Lansdell estimated that in the case of ordinary forest trees a man could clean four in a day; the cost of this would be worth while, as set against the serious losses of full-grown Beech in Beech woods, consequently on infestation by the Felt-scale.

On January 22nd of this year (1900), Prof. P. Hedworth Foulkes, writing to me from the College, Reading, mentioned that in the course of August in last summer he had a case of several Beech trees which it was an object to save, being infested by this "Felt-scale." These he treated by having them dressed as high up the stem as possible (by a whitewash brush) with paraffin, and the following day done over with clean water. The dressings proved a complete success, and the bark was in no way injured. Prof. Foulkes examined the trees within a week, and again a fortnight before date given above of his letter to me.

The above recipes may probably be of service as a means of stopping spread of this destructive attack, more especially as from the "felty" or flocculent secretion of the insects being, so far as we know, quite *insoluble* in water, it may be presumed that application of water without some addition which would either poison the insects or destroy

their shelters by adhering to the "Felt" (as of soft-soap, for instance) would be useless.

I should, however, think that, unless under very special circumstances of thickness of bark, or under very careful superintendence, the emulsion of soft-soap and paraffin was safer than that of paraffin undiluted.

For account of *Cryptococcus fagi*, with reference to writings of Continental and English specialists, see my Twenty-first Annual Report, pp. 6-10.

CAUSTIC ALKALI SOLUTION.

WINTER SPRAYING APPLICATION FOR BARK OF FRUIT-TREES.

On April 8th of the past season I was favoured by Mr. A. Ward, Head Gardener to the Lady Emily Foley (The Gardens, Stoke Edith Park, Hereford), with the following recipe for a caustic alkali solution, which he mentioned as being found by fruit-growers to be of great service in ridding fruit-trees of many of their insect foes. I am not personally acquainted with the action of the application, but, the recommendation coming from such a known horticulturist, I have no doubt that it is serviceable, and, if used according to Mr. Ward's directions, *safe*. Still, as operators are not always careful what they are about, a suggestion of care as to such a powerful solution possibly doing injury if settling on young shoots may not be out of place, and I have also italicised Mr. Ward's direction that the water should be *boiling when used in mixing* the ingredients, as this is an important point. Mr. Ward's communication is as follows:—

"The principal ingredients are crude potash (pearlash) and caustic (commercial) soda, and these chemicals should be of the best quality obtainable. The way to make the wash is as follows: take one pound of caustic soda and one pound of caustic potash, and place in separate buckets or tubs, and pour on sufficient *boiling* water to dissolve them. Then add the two solutions together and dilute with sufficient hot water to make ten gallons, when it is ready for use. This may be applied to Apple, Pear, Plum, and Cherry trees, also Gooseberry and Currant bushes. For Apricots, Peaches, and Nectarines a weaker solution, or one pound each of the chemicals to twelve and a half gallons of water had better be used, although I have used it full strength on these without harm resulting.

"The best time to apply it is when the trees are in a *dormant state*. All insects, together with their eggs, larvæ, chrysalids, scale (whether brown or the mussel species), and any aphides which may be hibernating in the rough bark of the trees, are killed off by its action, also lichen

and moss, and the wood is left quite bright and polished in appearance. The solution should be applied in the form of a spray, with a knapsack pump, or a Stott sprayer, fixed on the end of the branch attached to the tube or hose of a garden engine. Every part of the tree should be well wetted with it, paying particular attention to the stems—the rougher the bark the greater the need—and forcibly drive it into every crevice. Choose a fine still day for applying it, as windy weather results in much of the wash being lost.

“The person applying it should wear leather or indiarubber gloves on his hands and a suit of old clothes, as the spray being so caustic burns the skin, and would also soon spoil good clothes. For the same reason the operator should not allow the spray to blow in his face, and when mixing he should not hold his head over the buckets, as the ingredients boil violently for a few minutes. If these few simple precautions are taken it is perfectly safe to use, and does an immense amount of good. Where large quantities of wash are required, the ingredients may be placed together in a copper holding the required quantity of water, and afterwards boiled until the chemicals are dissolved, when it would at once be ready for use. However hot the wash may be, the spray is quite cool by the time it reaches the trees; the force with which it is driven out, and the fact of its coming in contact with the air bringing this about, so that there is nothing whatever to fear in this direction. I have used it now for several years past, and it has effected an immense amount of good on the fruit-trees at Stoke Edith.”—(A. W.)

DEER.

Red-bearded Bot Fly.

Cephenomyia rufibarbis, Meig., Brauer, and Schiner.

This is a large handsome fly, about three-quarters of an inch in length, of a very broad rounded make, the colour chiefly black or brown, variously marked and intermingled with reddish, olive brown, and white hairs, the hairs themselves being sometimes parti-coloured, and so hairy altogether as to appear clothed with fur. The body between the wings has a cross-band behind the head of tawny or olive brown above, lighter at the sides, and ending in a patch of very light hairs beneath the insertion of the wings. Abdomen with the fore part with blackish yellow, fox red, or gold-brown hairs; legs black with brown shanks; wings broad, about half inch an long, with blackish brown veins, and the lower part of the wings sometimes brownish. There appears to be a good deal of difference in colour in different specimens, but one marked characteristic is that the cheeks and mouth

parts are so thickly clothed with red hair as to appear like a *red beard running round the under part of the face*, from which the fly takes its popular English as well as its scientific specific name.

The species is parasitic in maggot state in the nostrils, throat, and mouth parts of the Red Deer. The flies lay their living maggots about the early part of the summer at the opening of the nostrils of the Deer, up which they work and travel onwards to the throat, adhering by their mouth-hooks. Early in March (or till April) they leave their host by dropping to the ground from the mouth or nose, and seek some dark shelter where they change to chrysalis condition, from which the fly appears in May or onwards until July, or possibly later in Britain, as the above notes are the dates of German observation. The specimens which have been kindly sent me by Mr. Dugald Campbell, Strathconan Forest, Muir of Ord, Ross-shire, N.B., were forwarded me early in June, 1896, and early in July, 1899.

We have no notes as yet (so far as I am aware) of the attack being injurious to us, but it is of some interest as having been unknown in Britain until 1894, when specimens were captured in Strath Carron, on the west of Ross-shire, N.B., only a few feet above high-water mark, and the species was also captured by Mr. L. W. Hinxman in the Cairngorm Mountains, in the county of Banff, in 1895.

In the past season the specimen sent me by Mr. Dugald Campbell, writing from Muir of Ord on Aug. 2nd, was accompanied by the note: "About three weeks ago, while sitting at an altitude of nearly three thousand feet above the sea level, a fly came and rested upon my head, which I unintentionally killed in the capture."—(D. C.) The specimen proved to be of "The Red-bearded Bot Fly," and in the case of a species which has a capacity for being injurious, but which has been so recently noticed as present with us, and is still so little reported, it may be of interest to give an observation of its presence at the great altitude named.*

STRAWBERRY.

Ground Beetle, Bat Beetle. *Harpalus ruficornis*, Fab.

A few observations were sent me from Norfolk and Suffolk during the past season of presence of Ground Beetles; an attack which was first noticed as injurious to Strawberry fruit at Woodborough, in Nottinghamshire, in 1894, and since then has become much more

* Reference to the paper by Mr. Percy H. Grimshaw, F.E.S., published in 1895, in 'Annals of Scottish Nat. History,' and of exhibition of specimens by him at meeting of Ent. Soc. in London, March 4th, 1896, will be found, with information on this infestation and figure from life, in my 'Twentieth Annual Report, pp. 56-59.

widely prevalent as a seriously destructive attack to both ripe and ripening Strawberry fruit, especially where grown in considerable areas for market supply. The three most common kinds are black strong made beetles, with strong biting jaws, long legs, and long horns, and from half an inch or rather more to about three-quarters of an inch in length, and of a somewhat flat and oval shape. The *H. ruficornis* is distinguishable by the legs and also the horns being usually red (whence the name of *ruficornis*); also by the wing-cases (so long as the specimens have not been rubbed) being covered with a thick yellowish or greyish down. Beneath the wing-cases there are powerful wings, which are not possessed by either of the other kinds. For this reason the *ruficornis*, which has a habit of transporting itself on the wing in numbers sufficient to be described as swarms on summer evenings, has a power of being much more troublesome than the others; of these the *Pterostichus* (= *Omasus*) *vulgaris* is a little larger than the foregoing, sometimes nearly two-thirds of an inch in length, and is wholly black and shining.

The *Pterostichus* (= *Steropus*) *madidus* may be as much as three-quarters of an inch in length, and is also black, unless the legs have red thighs, and also wingless, but distinguishable by the hinder edge of the fore body being a good deal narrower than the wing-cases. There is a smaller species, *Calathus cisteloides*, which is also injurious to Strawberry fruit, which is black with brownish red legs and horns, and has the wings wholly absent or imperfect, but this species is only from a quarter to half an inch in length, and is not as frequently reported as hurtful as the other, and especially as the winged kind *ruficornis*.

The method of attack is for the beetles to be under the earth round the Strawberry plants by day, in cracks in the ground or having holes and runs through the earth and litter; and after dark they come out and feed on the Strawberry fruit. Ripe or unripe are both liable to attack, which often is carried on by eating off the surface of the fruit or portions of it, or by clearing away the seeds or (in the case of the ripe fruit) by sometimes eating holes deeply into the substance of the berry.

It was not until July, 1898, that any serviceable practical method was reported of keeping the seriously destructive ravages of the beetles in check, but in that month, on the 19th, Messrs. Laxton, of Bedford, were good enough to inform me that they had almost entirely destroyed the beetles by the following plan:—"We purchased a large quantity of cheap pudding basins early this spring; these we let into the ground, level with the surface, at distances of a few yards apart, and kept them baited with pieces of 'lights' and sugar-water. When the weather was dry we often caught half a basinful of a night, until the

number gradually diminished to two or three, and now none at all." The above note not only shows the success of this simple plan, but also the vast number of beetles present, when they could be often caught in "half-basinsfuls." Another method by which "*enormous numbers*" of the beetles were caught at the Woburn Experimental Fruit Ground was by obtaining a number of empty condensed milk tins, and, after placing about half an inch of tar in the bottom of these, plunging them in the soil by the plants level to the rims.

Another simple method of trapping, by turning the habits of the beetles as carnivorous as well as fruit feeders to account, is placing pieces of "flesh covered by pieces of thick sacking" amongst the Strawberry plants, which attract the beetles, and thus many are caught and killed. The smell of the meat, however, in the hot weather usually accompanying the season of Strawberry ripening might be objectionable.

The specimens sent with observations of attack to Strawberries last season were entirely of the winged Ground or "Bat" Beetle, *Harpalus ruficornis*, but are unnecessary to give *in extenso*, as they only refer again to points such as the destructiveness and the method of the attack to the Strawberry fruit, which has previously been fully noticed. See my Annual Reports for 1894, 1895, 1897, and 1898.

In one instance mention is made of beer and sugar being successfully used as a bait in basins sunk in the ground, but, as the nature of the attack does not appear yet to be generally known, it has appeared worth while to refer to it again.

Another kind of attack—namely, that of what are popularly known as "Daddy Longlegs" grubs, scientifically the larvæ of *Tipula oleracea*, and also of *T. maculosa*—was reported as attacking Strawberry roots, and will be found noticed under the above heading—"Daddy Longlegs"—at pp. 29–31 preceding, as the infestation attacking several kinds of crops it is most convenient for reference to place the observations together.

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